PUBLIC WORKS

Devoted to the interests of the engineers and technical officials of the cities, counties and states

FEBRUARY, 1937

VOL. 68, NO. 2

Contents

Index for the year 1936 will be sent to subscribers on request.

TIMEWASTERS

A Pig Problem:

Ikey and Mikey each had a pig. Ikey's weighed 200 pounds dressed, and Mikey's 300 pounds. Ikey and Mikey agreed that Mikey was to dress and market both of them, for which Mikey was to get a half a cent a pound more than Ikey got. Mikey sold them for 6 cents a pound or a total of $30. What price per pound did each get? *R. A. Hartom.*

The Fox Comes Back:

The contributor of what was probably the best 1936 problem, H. A. Blunk, writes: "Referring to the dog and fox problem of the December, 1936 issue, and assuming that the fox crossed the road at his speed of 60 miles an hour and maintained the same rate, with what rate of speed must the automobile carrying the dog travel from a point exactly 1 mile north of where the fox crossed in order that the dog shall be able to smell the fox for exactly one second if 1,100 yards or 3,300 feet is the limit of his scent?" Mr. Blunk says that he is still working on this himself, but will send the answer soon. In the meantime, we excuse ourself because of pressure of work, and check this problem on to our little group of serious thinkers.

The Falling Flagpole:

A circular pavilion with a diameter of 20 feet is 10 feet high. A flagpole 100 feet high is located in the exact center of the pavilion. One of those high winds blew over the top portion of the flagpole, which in falling just touched the ground and the edge of the pavilion, while remaining attached to the lower portion of the pole. How much of the pole blew down? Contributed by *John Bevan.*

Some Solutions:

The bear-sized fox or the fox-sized bear, as you wish, weighed 66 pounds, according to our own figures and the computations of some reliable mathematicians. The watch problem, submitted by John Bevan, was not quite so simple, and solution is withheld for another month, subject to some checking to determine who is right and who is wrong. When experts disagree, yours truly moves very slowly. W. A. H.

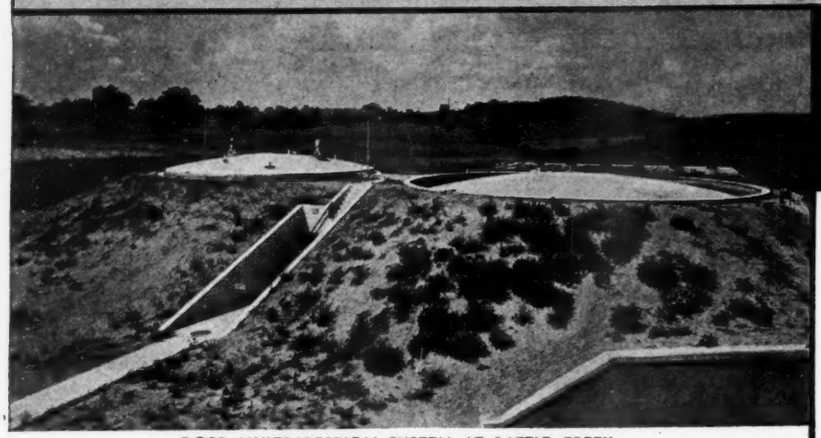
SUBSCRIPTION RATES: United States and Possessions, Canada, Mexico and Cuba, $3.00. All other countries, $4.00. Single Copies, 35 cents each.

A. PRESCOTT FOLWELL, Editor **W. A. HARDENBERGH,** Asso. Editor

Published monthly by the PUBLIC WORKS JOURNAL CORPORATION, 310 E. 45th St., New York, N. Y. J. T. MORRIS, *President;* W. A. HARDENBERGH, *Vice-Pres.;* CROXTON MORRIS, *Treasurer. Advertising representatives,* S. N. HUME, 310 E. 45th St., N. Y.; FRED R. JONES, 228 No. La Salle St., Chicago, Ill.; ALONZO HAWLEY, 1635 E. 25th St., Cleveland, Ohio. ARTHUR K. AKERS, 244 Tutwiler Hotel, Birmingham, Ala.

FOUNDED IN 1896

DORR MULTDIGESTION *at Battle Creek*



DORR MULTDIGESTION SYSTEM AT BATTLE CREEK

SHOWS

54.8% SOLID REDUCTION

65.7% VOLATILE REDUCTION

697 BTU PER CU. FT. OF GAS AND 65.5% METHANE

18 CU. FT. GAS PER POUND VOLATILE MATTER DIGESTED

Through the courtesy of N. G. Damoose, Engineer Manager of the Battle Creek, Mich. sewage treatment plant, we are giving below composite operating data on the Dorr Multdigestion System for the month of November, 1936. The Dorr Multdigestion System consists of a 45' x 25'-6" primary digester and a 60' x 22' secondary.

BATTLE CREEK, MICH. OPERATING DATA—NOVEMBER, 1936

Population	Contributing	40,000
	Equivalent Contributing (incl. ind. wastes)	68,800
Raw Sewage	Flow—M.G.D.	3.94
	Suspended Solids—Influent—P. P. M.	356
	Suspended Solids—Effluent—P. P. M.	104
	Suspended Solids—Removal—per cent	70.8
Raw Sludge	Volatile Solids—per cent	83.5
	Ash—per cent	16.5
Digested Sludge	Volatile Solids—per cent	63.4
	Ash—per cent	36.6
Reductions	Solid Matter—per cent	54.8
	Volatile Matter—per cent	65.7
Gas Production	Metered, exclusive wastage, cu. ft. per day	59,070
	Per capita per day (contrib. pop.)	1.475
	Per capita per day (equiv. pop.)	0.860
	Estimated, including wastage, cu. ft. per day	75,000
	Per capita, per day (contrib. pop.)	1.875
	Per capita, per day (equiv. pop.)	1.090
Gas Analysis	Heating value—B.T.U. per cu. ft.	697
	Methane content—per cent CH_4	65.5

The Dorr Multdigestion System consists of a heated and mechanically stirred primary tank and an unheated, plain secondary with an integral gas holder, supported by the gas. It assures a more completely digested sludge, greater gas production and a clearer supernatant. Today 29 installations are in use or on order, designed to serve a contributing population of 971,000 persons.

A note to our nearest office will bring further details and operating data.

DORRCO

Cities Using Dorr Multdigestion Systems

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Austin, Texas
Battle Creek, Mich.
Cedarhurst, L. I.
Colorado Springs, Colo.
Dixon, Ill.
Edwardsville, Ill.
Eldorado, Kans.
Elmhurst, Ill.
Fargo, N. D.
Fergus Falls, Minn.
Grand Forks, N. D.
Grand Island, Neb.
Hutchinson, Kans.
Iowa City, Iowa
Kokomo, Indiana
Lincoln, Illinois
Mansfield, Ohio
Monroe, Mich.
Natal, Brazil
Phoenix, Ariz.
Rahway Valley, N. J.
San Mateo, Cal.
Santa Clara, Cal.
Sheboygan, Wis.
Storm Lake, Iowa
Topeka, Kansas
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PUBLIC WORKS

City, County and State Engineering and Construction

Vol. 68 *February, 1937* No. 2

Remodeling Providence Sewage Plant With Modern Equipment Saves Money

AFTER ten years of planning, remodeling and new construction, Providence, R. I., has placed in operation a million dollar activated sludge plant at Fields Point, replacing one built in 1897 which continued in use until this new one was put into service. The general plan and beginning of construction were described in PUBLIC WORKS for August, 1931.

The old plant had for several years been treating 36 mgd instead of the 30 mgd for which it was designed. About $150 worth of chlorine and $40 worth of lime per day was being used, and it was estimated that the new plant would effect a saving in these expenses which would cover the cost of operating electrically the modern appliances included in it.

The present population of the city is about 252,000, of which 250,000 contribute sewage to the plant; in addition to which are the trade wastes of many textile and other industries. The 19 square miles of the city is sewered by three major sewers, only one of which, the Elmwood sewer, with a flow of 5 mgd, enters the plant by gravity.

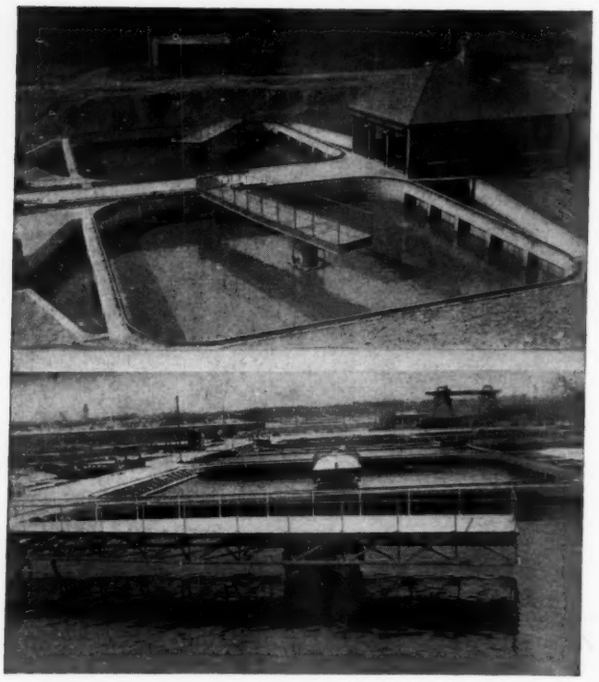
The New Plant

Reaching the treatment plant through an 88" brick sewer, the raw sewage first passes through two Dorr mechanically cleaned screens, 6 ft. wide with ¾" openings between bars. It then goes to two detritors, each 55 ft. square by 6½ deep at maximum flow, mechanically cleaned with Dorr equipment which makes one revolution in 12 minutes. The screens, detritors and inlet gates are housed in a new brick building 39 x 25 ft. with slate roof.

The screens have a nominal dry-weather capacity of 52 mgd. Although the present average dry-weather flow is 36 mgd, a maximum rate of 150 mgd has been reached. When the flow increases beyond the capacity of the screens, the excess is diverted automatically through a bypass directly to the grit chambers.

The screened sewage flows to three primary settling

General view of Providence sewage treatment plant. Three primary settling tanks in foreground. Aeration tanks in the background. Municipal wharf in extreme background.



Top—Two grit chambers, and service building over screens and inlet gates. Bottom—Primary settling tanks in foreground.

tanks, two of which are 100 ft. square and one 105 x 112 ft., giving a theoretical detention of 60 minutes. These are equipped with revolving sludge removers operated by 3 hp. motors.

The settled sewage flows to a pre-aeration tank 122 x 105 ft., divided by 12″ walls into six 19 ft. by 6 in. channels, through which it flows in series. After passing through the first channel it receives return activated sludge, and after passing through the other five it goes to sixteen spiral-flow diffused-air aeration tanks. (At present less than 25% return sludge is being added.) With a flow of approximately 32 mgd the aeration tanks give a detention period of six hours; when the flow increases to 48 mgd this will be reduced to four hours.

From the aeration tanks the sewage passes to five final settling tanks, each 102 ft. square and 10 ft. deep, giving a detention period of 1½ hrs. at average flow or about 1 hr. at maximum. The final tanks are equipped with Dorr sludge removers operated by 5 hp. motors.

Primary and excess activated sludges are treated with lime and ferric chloride, and dewatered in 16 Johnson filter presses, each containing 50 plates 36″ square, which formed a part of the old plant. The sludge cakes, about 1″ thick with 75% moisture, are taken by scow to the U. S. government dumping grounds in lower Narragansett bay.

A newly constructed pump house contains six Worthington 10″ return-sludge pumps, each with a capacity of 2½ mgd, electrically operated. On the mezzanine floor are pump controls and controls for operating the final tanks. An electric eye in each tank will automatically start the pumps when the sludge reaches a certain upper level, and shut them off when a given low is reached. Provision is made for manual operation also.

An existing chemical house was remodeled to hold three blowers operated by electricity derived from the city's new 160-ton incinerator constructed on land adjoining the sewage plant. The blowers use approximately 600 kwh per day. Sufficient current could be furnished to operate the sewage pumps also, should these be motorized. At present the pumps, approximately 40 yrs. old, are driven by steam, but it is planned to replace them eventually with motor-driven pumps.

In return for the electricity provided by the incinerator to the sewage plant, the latter furnishes an average of 3½ mgd of its final effluent for condenser use at the incinerator, which has to be pumped. After passing through the condensers, the water flows directly to the Providence river through a 110″ storm sewer. (This incinerator will be described in another article.)

Some Construction Details

Each of the two detritors has at its entrance 25 concrete deflectors to control the flow. These operate like the slats of a shutter, revolving on vertical rods. Each slat is 15″ long, 3″ wide at one end and 1″ at the other (the ends being rounded) and 6′ 2″ high, spaced 15½″ between centers. The deflectors are divided into groups of five in five separate sections divided by concrete walls. Each deflector contains, 3″ from the larger end, a 1″ vertical pipe sleeve and rests on a washer to permit movement, the sleeve revolving around a fixed rod. By these deflectors any number of openings can be closed, up to five of the six in each section. The deflectors are operated by a wrench fitting over the square head of the pipe sleeve.

The three partitions in each aeration tank were made of creosoted plank instead of concrete, which not only reduced the cost considerably but also left capacity for an additional million gallons of sewage. In placing these walls, bases for the columns (7 in each partition) were made of concrete all brought to the same elevation. The columns were set on these, plumbed carefully and their tops fastened to each other and to the side walls while a concrete ridge, continuous for each line of columns, was poured, these ridges being 2 ft. high and 12″ wide at the top. In setting the columns the contractor used an old Winton automobile from the chassis of which everything but the driver's seat had been removed, and on the rear was set a hand-operated derrick. This portable derrick was lifted from one tank to the other by a large derrick.

At the entrance to each final tank was erected a series of baffles extending from 1 ft. below the flow line to 4 ft. below and across the 100 ft. width of the tank. These consisted of 1″ boards nailed to 2″ x 4″ vertical strips, which were supported in place by 4″ x ¾″ galvanized iron straps bolted to the end wall.

The aeration tanks are in two rows separated by an operating gallery 5′ 8″ by 8′ 9″ (formerly used as a sludge gallery). This was roofed over with a 12″ reinforced concrete slab, from which the air pipe, 24″ to 20″ diameter, was suspended. Several stairways at openings in this roof give access to the gallery. In installing the air lines, the individual pipes were lowered through the stair openings onto a set of jacks mounted on a 4-wheel carriage, which was then drawn to the proper position in the tunnel and lifted to the proper elevation and fastened. This proved an expeditious and cheap method of handling this problem.

The concrete used was mixed for a strength of 3,000 lbs. (which the tests proved to be conservative) according to the water-cement ratio, the proportion being 1:1.82:2.12, with the stone 50% pea and 50% No. 2 by weight, screen tests being made frequently. All concrete was obtained from a local transit mix company. In spite of the fact that much of the work was done during cold weather, excellent results appear to have been obtained.

The engineers so planned the project that the old plant was used until it was possible to switch to the new. The primary tanks of the old system are now used as clarifiers, the bottoms being given the proper elevation and a flat-cone shape by fill about 12″ deep covered with reinforced concrete. Those parts of the plant which are new construction were finished first, these including the screens, inlet gates, detritors and the building that houses them, the 88″ brick sewer and the pump house.

By this use of the old plant the cost of the new plant was kept down to slightly less than a million dollars—about $20,000 per mgd capacity—instead of the three million estimated cost of an entirely new one. Incidentally, the total cost was approximately the same as the estimate made twelve years ago, although individual items varied one way or the other.

The contractors for the various portions of the work were as folllws:

Preliminary excavation, Lawton Construction Co.
Grit chambers, two primary clarifiers and five final clarifiers, C. B. Maguire Co.
One primary clarifier, one pre-aeration tank, 16 aeration tanks, remodeling compressor house, new return sludge pump house and air piping, The Tucker Construction Co.
(The Files Engineering Co. handled the air piping job as subcontractors for the Tucker Company.)
Air compressors and air filters, Roots-Connersville Blower Co.
Porous diffuser plates, Carborundum Co.
Return sludge pumps, Worthington Co.
Machinery for screens, detritors, and clarifiers, Dorr Co.

Aeration tanks under construction. Top—Columns set and concrete bases poured. Bottom—Tanks practically completed. Pipe gallery tunnel extends from front to rear. In foreground, stairway opening through which pipe was lowered.

Consolidation of Non-Cohesive Soils for Road Bases

IN preparing previously unconsolidated ground to receive pavements to carry heavy traffic, artificial consolidation may be necessary. Determination of the necessity of this involves four considerations: (a) determining the degree of uniformity of the soil; this involves extensive sampling followed by tests for void content, particle size, etc. (b) Deciding on the degree of consolidation required; it is noted that in this connection uniformity is of more importance than the actual maximum degree of consolidation obtained. (c) Testing the extent and degree of consolidation by the study of sample cores; comparative measurements of depth before and after compaction, especially where spreading is possible, e.g., near the sides of an embankment; dynamic testing; measurements of resistance to penetration, e.g., by means of the PROCTOR needle. (d) Selection of the machinery best suited to local conditions.

Methods of Consolidation

Where the particles are uniform in shape and size, the process of compaction consists in forcing them by means of a series of impacts into the closest possible formation. If the particles are not uniform, the filling of the voids is more difficult, and it is in connection with soils of this type that wet methods of consolidation have proved most useful.

For consolidating sandy soils, the following are among the most important processes now in use.

(1) *Ponding.*—The upper surface is ridged transversely and covered with water; although percolation is frequently checked by the formation of a slimy deposit on the surface, a considerable amount of moisture penetrates into the interior. The degree of consolidation actually produced is comparatively small, but the treatment forms a valuable preparation for mechanical tamping.

(2) *Washing with water jets.*—Soil is placed on both sides of the site and washed towards the centre by pressure-operated jets of water. If clay is present, the levigating effect of the water may result in the formation of pockets of clay, which may cause appreciable subsidence at later stages. The general texture of the deposited soil is considered too open.

(3) *The tamping plate.*—An iron or steel plate, 28 to 32 in. square and weighing 2 to 4 tons is raised mechanically to a height of 5 to 7 ft. from the ground and allowed to fall freely. The degree of compaction produced in dry soil is somewhat less than in ponded soil, but the effects are more evenly distributed. The method employed, either alone or in conjunction with other methods, is applicable to consolidation work of almost all types. The machine is capable of producing a 50 per cent. compaction at a depth of 30 in. in soils of uniform particle size and shape. An increase in the weight of the plate and/or the height from which it is dropped does not necessarily result in improved compaction, as spreading may be produced. Freshly-placed soil should be treated in layers not exceeding 48 in. thick, the consolidation thickness in this instance being 40 in.

(4) *The "Frog" ramming machine.*—A hand-guided tamper operated by an internal Diesel engine. The area treated is about 28 in. square; the maximum tamping effect is usually obtained after three blows. The 1-ton model is capable of treating 290 sq. yds. per hour, 27 per cent. compaction being obtained at a depth of 30 in. with three blows. The depth of soil treated should not as a rule exceed 24 to 30 in. The machine is thus less effective than the tamping plate, although it is more mobile and more easily operated.

(5) *Tamping machines operated by compressed air.*—These usually consist of five upright tamping units. The five plates are 10 in. square and 10 in. apart, the effective width treated being thus 7½ ft. The machine is said to exert a combined tamping and vibrating action, the frequency of the latter being about 1,200 per min. After 30 to 40 secs.' operations the machine is moved forward 20 in. If the working period is 30 secs., 132 sq. yds. of soil can be consolidated per hour. Maximum compaction is effected at a depth of 12 in., the degree of consolidation being about 20 per cent. less than that obtained with the tamping plate.

(6) A heavy *tamping machine* containing four parallel 1½-ton units, and capable of consolidating 600 sq. yds. per hour. Test results are not available.

(7) *Vibrators.*—The machine described is a 24-ton tractor-wheeled model carrying a vibrating plate having an effective surface of 9 sq. yds. and operating at a frequency of about 13 to 15 Hertz. A nearly uniform 60 per cent. compaction is produced to a depth of 32 in. by vibration alone, whilst further but less regular compaction is effected by the vibration of previously tamped material. The method is applicable to greater depths than any of the preceding mechanical methods, and it is particularly effective in cohesionless soils.

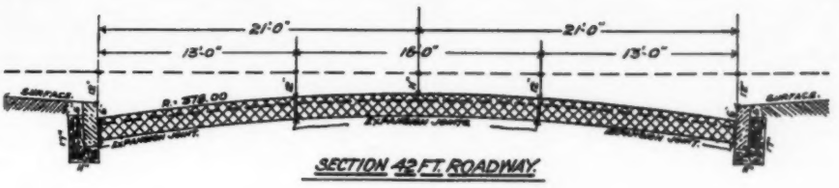
(8) *Rollers.*—These are more successful on cohesive soils than on sand, into which the wheels sink even when the rims are corrugated.

(9) *The Franki pile driving method.*—A hollow steel drill is forced into the soil and filled with gravel which is tamped by means of a 3-ton rammer during the withdrawal of the tube. The method, which is of recent development, has been used experimentally in the consolidation of an earthwork consisting of layers of sand about 50 ft. thick. About 440 cu. yds. of gravel were thus introduced over a superficial area of 360 sq. yds.; at the conclusion of the process the depth had been diminished by 4 in., corresponding with a reduction of the void content from 42 to 35 per cent., and with an increase of about 100 per cent. in the bearing power of the soil.

(10) *Combined vibration and hydraulic pressure.*—Water is forced into the soil, which is vibrated at the same time at a frequency of 3,000 per min. Results of field tests are not yet available, but it is stated that the compaction produced in sandy soils exceeds that obtained by any other known method. The author points out that further settlement under traffic is probable in all artificially consolidated soils, whatever the degree of compaction obtained at the time of construction, and that ground which has settled naturally is capable of very considerable further consolidation, the degree of compaction obtained by natural settlement being normally of the order of 20 to 23 per cent.

From an article by W. Loos in *Strassenbau*, as condensed in "Road Abstracts."

By WALTER L. CLARKSON
City Engineer, Bayonne, N. J.



Methods Used in Repaving a Busy Street

BROADWAY, the "Main Street" of Bayonne, N. J., extends for the entire length of the city, a distance of about three miles, and is the connecting link between the Staten Island ferry (by which the shore resorts of South Jersey are reached) and Jersey City and the Metropolitan district of New York.

It was originally, for the greater part of its length, a plank road and was so known. In 1883, it was paved with 16" water-bound telford macadam and was maintained as such until 1909, by which time its further maintenance became a practical impossibility; it was therefore then resurfaced, but with an inferior grade of bituminous mixture which, in turn, deteriorated to such an extent that traffic thereon became hazardous. As Broadway traverses the heart of the main business district of the city and is very heavily and constantly traveled by both pleasure and business vehicles as well as by an important and well patronized system of busses, and the condition of the roadway became such that much of this traffic was being diverted to non-business parallel avenues, to the material detriment of both business and bus line, its repaving became an economic necessity.

Walter L. Clarkson

The city therefore negotiated with the Federal Emergency Administration of Public Works for funds with which to finance the reimprovement of said street, which funds were obtained in the form of a loan and grant from which the cost of the work was paid, the actual construction cost being $362,000, while the gross cost, including supervision, legal fees, etc., amounted to $380,000.

The work, which was completed on June 3rd, 1936, included the removal of all old paving material, which was accomplished with excavating machinery; the replacement of all old bluestone curb with new 4" x 16" granite curb; increasing the curb corner radius from five feet to ten feet, and replacing concrete sidewalk adjacent thereto. It also involved the removal of all old short-radius granite catch basin heads and substituting new ten-foot radius cast-iron heads and grates therefor, together with much subsurface drainage and water work.

In order to provide for the removal of all unsightly telegraph poles from the line of the work, there was installed a complete underground conduit police and fire alarm signal system, and the Public Service Electric and Gas Company installed a complete underground lighting system with ornamental iron posts; all of which resulted in the elimination of all wooden poles, which enhances the appearance of the street and adds value to the properties fronting thereon.

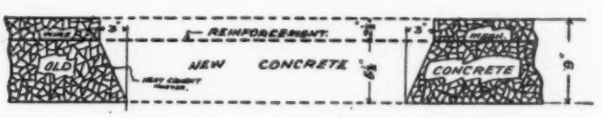
The roadway was paved with a 9" reinforced concrete three-slab roadway. As the width between curbs varied from 42 feet to 48 feet, the center slab was maintained at a uniform width of 16 feet, the outer or curb slabs varying from 13 to 16 feet in width.

Due to the necessity of keeping the roadway open to bus and business traffic and fire apparatus, the specifications required that at least one, and wherever possible two, lanes of traffic were to be kept open, which was consistently done during construction. To facilitate the opening of the pavement to public use as rapidly as possible, high-early-strength cement concrete was used throughout.

The concrete mixture consisted of 1 part high-early-strength portland cement; 1¾ parts cow bay sand, and 3½ parts of traprock, graded from ¼" to 2¼". All concrete was batched at the plant by means of accurate measuring hoppers and delivered on the job dry, the cement being added on the ground. The water was added from a measuring tank on the mixer, the amount being governed by the amount of moisture in the coarse aggregates.

The slabs were generally 38' 8" long, but this length was necessarily modified at street intersections for the

Broadway, North and South from 22nd Street.



Method of repairing street openings.

purpose of placing transverse joints in the center of all intersecting streets.

Reinforcement consisted of No. 4 gauge wire mesh spaced 6″ apart both ways and placed 2½″ from the surface, supplemented by ¾″ x 48″ "hair pin" reinforcement bars at each corner of each slab. Also ¾″ x 36″ dowel pins, one end sheathed in paper slip tubes, spaced 12″ apart, were inserted in all transverse joints.

A ⅜″ x 9″ premoulded expansion joint was used on all longitudinal and transverse joints, and was also used between the curb and the pavement for the entire length of the work; the reinforcing material being countersunk ½″ and the joint poured with bitumen. The pavement was finished with a vibrating tamping machine mounted on a channel iron templet, and long-handled wood floats, followed by the use of burlap drags and broom finished.

Curing was effected by the use of an asphaltic emulsion applied by a long-handled sprayer supplied from pressure tank, as soon as the water glaze had disappeared.

Before this improvement was commenced, all property owners and the telephone, gas and electric utility companies were given ample notice to make any and all necessary installations, replacements and repairs to subsurface facilities; but as it was inevitable that future cuts in the pavement would become necessary for the purpose of repairing water and gas leaks, etc., a diagram of the method of replacing the same has been designed for the use of the Department of Public Works, which makes all such repairs. This provides for cutting the shoulders of the opening vertically for a depth of 2½″ (or to the line of reinforcement), from which point the concrete is beveled to prevent possible future settlement. All joints are painted with neat cement wash immediately before the new concrete is placed. The result has been that such repairs are practically invisible and are flush with adjacent pavement.

The plans and specifications were prepared and the construction was supervised by the city engineer, who was assisted in the supervision of the work by Chief Inspector William Finnegan. Eugene T. McCarthy was the Director of Public Works. The contractor was the Nesto Contracting Company, Inc., of Newark, N. J., for whom Joseph E. Wagner, of the Warranty Paving Company of East Orange, N. J., was the superintendent in charge; with Dominic Bellazza of the New Jersey Asphalt and Paving Company of Jersey City as associate superintendent.

All concrete materials were furnished by James Brady Company of Bayonne. Reinforcement, expansion joint, etc., was furnished by Stulz-Sicles Company of Newark; cast iron basin and manhole heads by Campbell Foundry Company of Harrison; and granite curb by Charles W. Harlow, Jr., from the Pine Mountain Quarry Company of Atlanta, Ga.

Incinerator for burning picnic trash in a Cincinnati park.

Strength of Bond in Brick Masonary

RESEARCH in brick masonry, including effect of character of brick and of mortar in strength and water-tightness of joints, has for some time been conducted at the Massachusetts Institute of Technology under the supervision of Prof. Walter C. Voss. At the eighteenth annual convention of the National Lime Association he presented a progress report of this research in which he stated that their investigations seem to show that:

"Mortars should contain from 1 to 1½ parts of active slaked lime per volume of cement and not over 2½ parts of sand for each volume of cementitious material measured separately.

"Brick should be laid dry, should preferably be smooth, and should have a 48-hour absorption between 4-8%.

"All of these tests have to do with strength of bond and its relation to the strength of the mortar."

Concerning porosity of brick, he said that "bricks with low absorption are detrimental to all mortars in bond. Brick with 15% absorption are bad for all mortars, and the brick with medium absorption (4-8%) give the best results with all mortars."

It has generally been considered by builders, architects and engineers that wetting brick before laying is almost necessary for good bond, but Prof. Voss says that "wetting brick with low or medium absorption is detrimental, but the high-absorption brick are slightly aided by wetting, but not enough to take the chance that the wetting would be properly done." Inspection of the tabulated results of tests show that this varies greatly with the relative proportions of cement and lime in the mortar. When using 1 cement to 2 lime, the bond strength with wet brick was 15 lb. per sq. in. for brick of 15% absorption and 37 lb. for brick of 4-8% absorption, cement mortar without lime gave 43 lb. for brick of 15% absorption and 35 lb. for those of 4-8% absorption. However, the highest strength of all, 63 lb., was with dry 4-8% brick using cement alone, the next highest with 1:1 mortar and dry 4-8% brick; but with 1:2 mortar and 4-8% brick, wet and dry brick gave practically the same bond—36 lb.

Ornamental Park Rubbish Incinerator

In one of the large parks near Cincinnati, O., the waste left by campers and picnickers is burned in a large incinerator which was designed to be unobjectionable in appearance. It is built of native stone in the form of a tower 20 feet high—a trunicated pyramid forming the chimney, while the rectangular base contains furnace grates on which is burned the trash, and wood for fuel when necessary. A ramp is provided to enable trucks to unload directly onto a sloping charging floor from which the grate is fed. Several truck loads of trash are burned a day during the picnic season.

Blasting to Prevent Ice Jams and Flooding

SPRING floods are annual occurrences in all northern rivers. In some streams they threaten no damage, but along many streams some damage seems almost inevitable, the amount depending on various conditions, among the most important of which is the ice in the river which may jam and dam back the flood water. These jams can be broken, but the foresighted and most effective plan is to prevent them. This has been done during the past three winters on the Raritan river by the New Jersey Board of Commerce and Navigation.

The procedure is to blast a line of weakness, if not a continuous open channel, in the ice along the river channel, at each potential jam site. In this stream, tidal cracks keep the river ice weak along both shores, and when a thaw is expected (about the middle of February) the ice in the center of the stream at danger points is blasted. Then, when the up-stream ice come down it readily opens a channel for itself.

In 1936 work on the Raritan began on Feb. 15 by blasting short channels wherever ice jams had occurred in previous years. Holes were cut through the ice about 8 ft. apart, and in these were suspended bundles of three to five 1¼″ x 8″ cartridges of 40% ammonia dynamite, primed with No. 6 electric blasting caps (whose leg wires should be long enough to join directly cap to cap, so that extra splices will be avoided) waterproofed with a hard grease known as Albany pressure grease No. 0. The charges were hung from sticks across the holes so as to be about 18″ below the bottom of the ice.

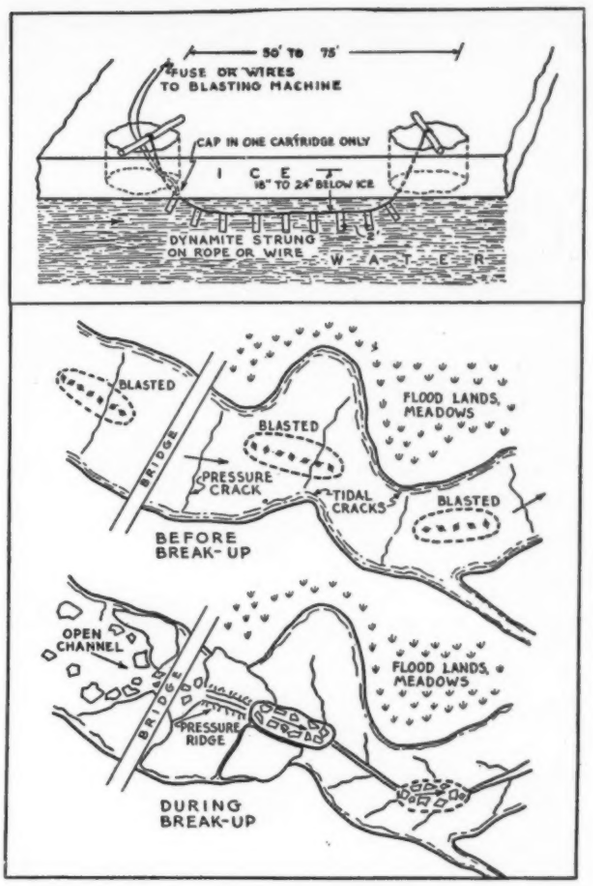
In cutting the holes, ice chisels are far superior to an axe. The chisel should be about 5′ long, have a 2½″ to 3″ blade, weigh 12 to 14 lbs., and have a ball on the upper end to prevent it slipping through the hands.

Ammonia dynamite is seldom used in submarine blasting, but was used in this case so that, should a charge be lost (none was on this entire job) it would be less likely, after long soaking, to be dangerous to water craft than would the more water-resisting gelatin type. The ammonia dynamite was never submerged more than 15 minutes before firing. If longer immersion was necessary, 60% gelatin was used.

Where particularly long cuts were needed, propogated blasts in holes 4 ft. apart were employed, using two 60% L.F. nitroglycerine dynamite cartridges. A cut 110 ft. long averaging 22 ft. wide was made with 28 holes so prepared.

Another method of using the propagated blast is to cut two holes in the ice, one 50 to 100 ft. down from the other, float from the upper to the lower hole a can tied to a cord, tie to the cord 2 cartridges of nitroglycerin dynamite at 3 ft. intervals, pull the cord back up stream and discharge an end cartridge.

To break up a large drifting floe, bind 3 cartridges together with soft wire the ends of which are twisted together and left projecting about an inch (to prevent the bundles from rolling) insert and light a fuse and push the bundle out onto the ice. Or a charge can be placed under a floe by tying it to a float with a long cord so that, when the float is stopped by the ice, the explosive will be carried under the ice by the current.



Above—Preparing for a propagated blast. Below—In a break-up the ice rams a channel from one previously blasted area to the next.

Safety fuse is used and must be carefully waterproofed.

In this work, a light truck for land transport, and a rowboat fitted with runners are almost essential. Ice creepers for the men, small sleds and a length of stout rope for emergencies are desirable. The blasting crew on the Raritan river last February comprised 5 men, working for 19 shifts, in charge of L. C. Longstreet, from whose description in "The Explosives Engineer" the above has been abstracted. In concluding, Mr. Longstreet said: "We do not wait for the break-up to create dangerous situations, then hope to relieve them by spectacular bombing or blasting ventures. We study the river and its habits—seeking the danger spots that an old river man could point out almost instinctively—then blast accordingly. Not too soon, for that would only waste explosives, but in time to prepare for the inevitable thaw and rise of the stream. We watch for pipe lines, cables, and other property that might be damaged. Bridges are usually looked on as probable jam sites. We blast under the ice whenever possible, for two reasons: it is more effective, and there is less noise to disturb people on shore.

"The central idea in all preliminary work is, not to create an open channel, but to make a line of weakness, and thus direct the tremendous force of the current and the floating ice toward cutting its own channel. In a few instances the preliminary cuts are pointed in such a way that the ice battering its way downstream in the break-up will tend to force its way out onto flat meadow land along the shore, where also an especially high flood stage can find relief without damaging more valuable property. The rule, however, once the ice starts to move, is to keep it moving."

Fifty Essentials of Swimming Pool Design

By CHAUNCEY A. HYATT
State Swimming Pool Sanitarian, Illinois Department of Public Health.

THE proper design of a successful swimming pool and its attendant facilities is not as simple as most people believe. Of course, anyone can design a swimming pool, but unless a pool has certain fundamentals it will not continue to function successfully and be an asset.

2. Obtain all the available information from as many sources as possible; then, with an open mind, try to take advantage of this information in your particular installation.

Why swimming pools are needed
A sign on Des Plaines river

3. A great deal of conflict in opinions occurs regarding many features of pool design. The blind men who examined the elephant all had different conceptions although entirely sincere in their beliefs. They all approached the matter from different angles and only by combining their reactions could the real truth be arrived at.

4. Much misinformation exists in regard to swimming pool design. Sometimes this results from overzealous salesmen who are primarily anxious to make a sale, sometimes from persons who make general deductions based on a very limited experience.

5. Dr. Hamilton Montgomery, M.D. of the Mayo Clinic, in a staff discussion of this subject said: "To build a modern outdoor swimming pool one should have the advice and assistance of an architect, a construction engineer, an expert on filtration equipment and purification of water supply, a public health official, and various physicians, especially a bacteriologist, an ophthalmologist, an otolaryngolist, and a dermatologist."

The above is a very modest statement of the problem and could be amplified to include even more talent, particularly to include a high-class experienced pool operator who is familiar with the features which are so necessary for successful operation.

6. Most pools go off "half-cocked" in the matter of design. When word comes to go ahead on a new pool, excavation or some visible activity must commence at once or it is thought enthusiasm will become lukewarm.

7. Potential demand both as to number of users and also as to function should be considered. Most outdoor pools are too large! A certain type of layout may be ideal for an athletic club or a college and still be entirely unadapted for a community pool.

8. An over-sized pool usually does not have adequate water treatment or, if it does, then the expense of maintenance is so high that recirculation is only turned on a few hours per day.

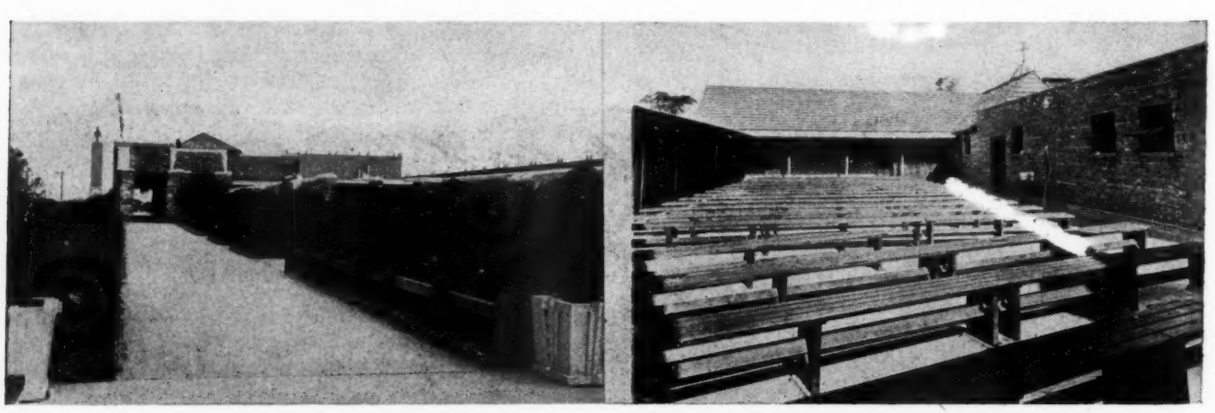
It is not economical to build a pool large enough to comfortably accommodate peak crowds which may only come once or twice a season and operate at a loss all the rest of the time.

9. The considerations in determining a pool's location are numerous, but a few of the important items to consider are: Whether the pool is to fit into a park scheme or city planning arrangement; the transportation facilities to the pool site, or in other words its accessibility; an adequate source of water supply is necessary; the topography of the site is important from the standpoint of providing subsurface drainage, preferably without pumping; it should not be located where it will receive soot, dust, material, etc., from incinerators, or leaves from nearby wooded areas.

10. A clean, attractive pool and surroundings instill confidence in the prospective bather and tend to prevent the patron from unjustly blaming the pool for certain infections which he may have contracted elsewhere.

11. If a pool and its attendant facilities are to be kept clean they must be made easy to clean! Floor drainage and ample hose connections (one inch or larger) should be provided at frequent points.

12. Pool dimensions are usually dictated by the space available, competitive requirements, type of patrons, etc. Suggested lengths are as follows: 20 yds.; 25 yds.; 25 meters are the standard lengths for indoor pools. In outdoor pools the favored lengths would include the above and in addition the following: 40 yds. 50 yds. 50 meters (164'+), 100 yds. and 100 m[illegible]



Jones Beach, New York **Whealen Pool, Illinois**
Illustrations of Open Court type of bath house for outdoor pools

Forty yards is not entirely satisfactory but is preferable to any other dimension between 25 meters and 50 yds.

Widths should take into consideration the fact that the lanes should be a minimum of six feet in width and four in number. In competitive pools the lanes should be seven feet as a minimum and not less than six (preferably eight) should be provided.

13. Where lanes are provided on the bottom of the pool, bear in mind the swimmer travels over the lane and not between them. Diving equipment or other obstructions should not interfere with the use of these lanes or any one of them.

14. Pools may be designed in a variety of shapes, but the rectangular pool is by far the most popular and practical.

15. The arrangement in the case of outdoor pools located along public thoroughfares should be such as to obtain the maximum display or advertising value. The bathhouse should be located in the background with the pool out where folks may see what a lot of fun the patrons are having.

16. Provision for spectators is important. They are potential customers, and if they are provided with a good view of the facilities they will soon find their way inside. The spectator area should be at a point of vantage. The long dimension of the pool should be in a north and south direction with the spectators on the west with their backs to the sun during the afternoon, which will undoubtedly be the most popular time for their presence. They should be at right angles to the diving to make this event as attractive as possible.

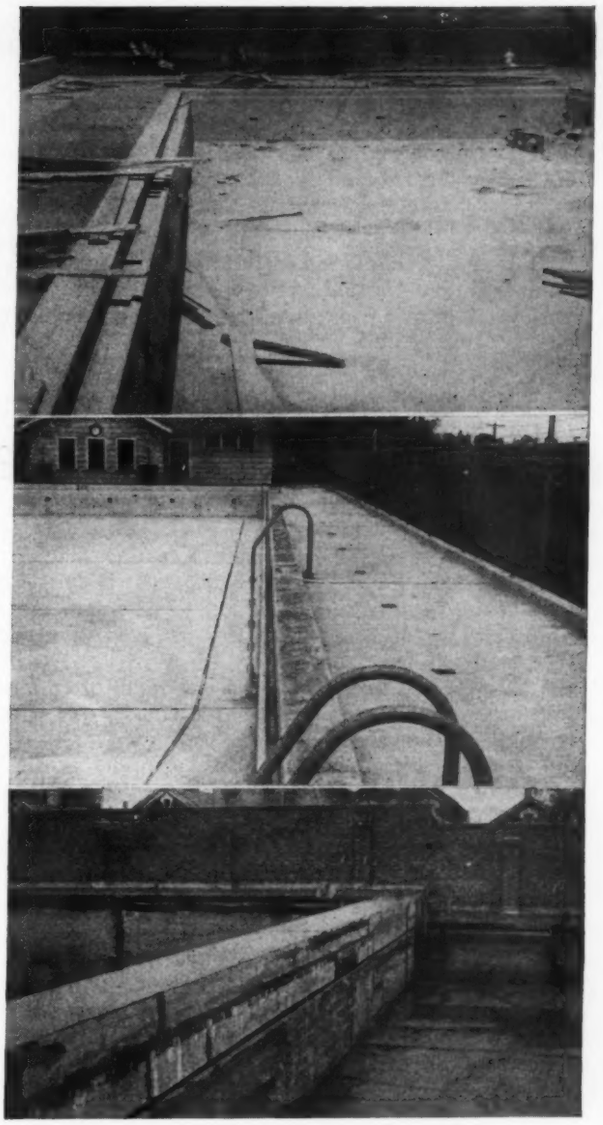
17. Parking facilities should be adequate, including illumination, proper surfacing and drainage, and location as convenient as possible to the dressing facilities.

18. The contour of the pool bottom, especially the deep section, is dictated by the diving requirements. A "double spoon" or hopper bottom undoubtedly represents the most up to date development of this feature. This type of contour results in greater economy of pool structure, reduces the volume of water necessary for treatment, and also has an advantage in operation because a hopper bottom assists in the the movement of bottom accumulations, which tend to work to the low points.

19. Concrete is the material almost always used in the basic construction. When not finished with tile, terra cotta or precast slab for the inner lining, the walls should be surfaced as smooth as possible to prevent accumulations. The pool bottom should be finished with a top layer of white cement and white aggregate, which will tend to show the water to advantage and preclude the necessity of painting, which is seldom satisfactory. If white cement and aggregate are used, the bottom must be protected during construction to prevent soiling and staining.

20. Overflows (commonly known as scum gutters) should completely surround the perimeter of the pool. Their function is to serve primarily in removing surface accumulations and not as a hand rail. To function successfully, the overflow must be absolutely level. If overflows are to be kept clean they must be accessible; therefore the open type is by far the most desirable. Overflows should pitch not less than 3 inches in 10 feet to drains which should be ample in size and located not more than fifteen feet apart.

21. Walk areas which surround pools are an extremely important part of pool design, but one usually neglected. The surface should be non-slip to bare feet, easy to clean, and pitched preferably away from the pool not less than 3 inches in ten feet. Walks should be as wide as possible, particularly at the diving board section.



Top—Open type overflows (scum gutters) are usually kept clean for two principal reasons—they are accessible, and the accumulations are conspicuous.

Bottom—A recessed overflow; very difficult to keep clean and lives up to its name.

Middle—Well designed walk area illustrating curb at outside edge to keep out litter and act as base for fence.

22. The walk area should be provided at the outer edge with a curb to keep out litter and dirt from the spectator area. Walk areas should have ample hose connections (one inch or larger) for cleaning.

23. Pools should in all cases be surrounded by barriers to keep persons other than bathers out of the pool proper, and also to keep the bathers from entering sand or grass areas and returning to the pool with the accumulated dirt.

24. Fill and draw pools are out! Unless water of the proper temperature and in such quantity (without pumping) that three times the volume of the pool is available every twenty-four hours, recirculation should be included in any pool which is to continue to maintain its position on a par with our present standards. An eight-hour turnover or less should be provided in all cases, at the rate of three gallons per square foot per minute for the filter area available.

25. Main drains should be located at the lowest point of the pool bottom and in outdoor pools protected by a grating of such area that leaves, a bathing cap, or other accumulation will not choke them and cut down recirculation.

26. Drain connections need not be excessive in size (not larger than needed for recirculation) and should never be connected to sewers so that surcharge is possible!

27. Pool illumination is important.

Underwater units should be of a type easily accessible (preferably from a pool tunnel). The fitting should be flush with the wall.

Overhead lighting units should be located at such points that insects attracted by the lights fall outside the pool and pool walks. Underwater lighting makes for greater pool safety (drowning) and makes it imperative that the clarity of the water be maintained above reproach, also it makes bottom accumulations conspicuous and hence more liable to be removed.

28. Better water is needed for swimming than for drinking purposes! In swimming, the entire body is exposed, eyes, ears, nose, etc., and the whole skin area, while only the alimentary tract is involved in water when used as a beverage.

A turbidity of 1 in drinking water would go unnoticed to the average consumer, but a modern pool with a turbidity of 1 would be decidedly unattractive looking and objectionable. "A swimming pool is the greatest volume of water on exhibit to be found in any community."

29. Hair strainers of a type easily accessible (location) and of such design that they can be opened quickly (one bolt) should be located ahead of the recirculation pump, protecting all lines connected to the pump suction, (including suction cleaner line and make-up line).

30. Chlorine still holds the advantage for disinfection. Application should be made on pump suction ahead of the filter to obtain better mixing and keep the filter material as sweet and wholesome as possible.

31. To prevent any cross connection between the pool recirculation system and the potable supply, the use of a surge tank probably is the most satisfactory solution, although a barometric loop thirty-five feet above the maximum pool level where the connection is to the pump suction will prevent any back syphonage.

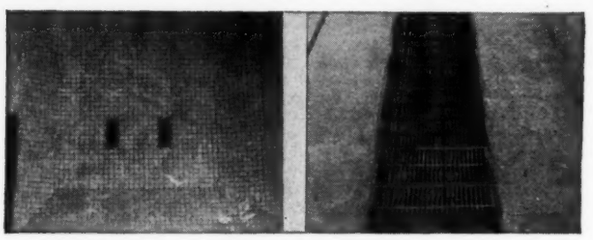
If the pool is in a building, the supply may be taken from a point thirty-five feet above the maximum pool level and the result will be the same.

The remaining 19 essentials will be found in our March issue.

Twenty-fifth Anniversary of Johns Hopkins School of Engineering

THE twenty-fifth year of instruction and research at the Johns Hopkins School of Engineering will be celebrated by a program of public events scheduled for February 19th, 20th and 22nd. An industrial and laboratory exhibit in the Homewood buildings, technical sessions, and addresses by prominent scientists and technologists will form the program.

Dr. Karl T. Compton, president of Massachusetts Institute of Technology, will deliver the principal address at the University's sixty-first Commemoration Day Exercises on the morning of the 22nd. Honorary degrees will be conferred on several distinguished engineers at that time. Later in the day Prof. Niels Bohr, director of the Institute for Theoretical Physics of the University of Copenhagen, will speak in the A. R. L. Dohme lecture series on the topic, "The Problem of Causality in Atomic Theory." Professor Bohr won the Nobel Prize in 1922.



Main drains should be protected by gratings of ample area to prevent clogging by leaves, bathing caps and other debris. At the right, a satisfactory type of main drain with ample area.

Senior faculty members of the School will read papers on special research problems at the sessions on the morning of the 20th. Professors from other colleges and officials of the City and State will take part in the informal discussion period to follow. One of the papers will be that written by the late Prof. J. H. Gregory, and originally intended to be read by him, on the subject, "Accomplishments in Water Purification." Professor Gregory, until his death on January 18th, was actively engaged in study and experiments in the forefront of sanitary engineering.

At the climax of the celebration, the Alumni Dinner on the evening of February 22nd, Abel Wolman, a member of the first graduating class of the School, will be the chief speaker. Mr. Wolman is chief engineer of the Maryland State Department of Health, chairman of the Maryland State Planning Commission and of the important Water Resources Committee of the National Resources Committee, and a widely known lecturer, author and consultant in the field of public engineering.

Various industrial applications of principles and methods developed in engineering laboratories and many recent discoveries will feature the exhibit. Experiments in the branches of electricity, combustible gases, mechanics and power engineering will be conducted by students so that visitors may have opportunity to observe the methods and facilities of up-to-date laboratories. In the highway laboratory, tests of construction materials will be run and the means whereby stresses and deflections of a new type of tubular steel bridge pile may be determined on a scale model will be shown.

A structural welding operation, experiments on the flow and pumping of water, sanitary engineering equipment, and actuated dioramas of flood control and slum clearance projects will be on view. Motion pictures on highway safety and a device for testing the fitness of automobile drivers, which may be tried out by visitors to the show, will afford interesting material for safety engineers. A chronological panorama of the development of transportation facilities and models of bridges, trains and aeroplanes will round out the civil engineering portion of the exhibit.

Prof. J. T. Thompson, who has served for a number of years as Highway Research Specialist for the U. S. Bureau of Public Roads, has had access to much of the basic data relating to scientific motor vehicle taxation. At the conference session he will outline a method whereby taxation may be equitably determined on the basis of the pro-rated annual cost of improvement necessary for successively heavier classes of equipment.

The Editor's Page

Emergency Water Treatment in Flood Times

One serious accompaniment of this year's disastrous floods is the scarcity of water for public consumption, the damage done to plants needed for purifying such supplies, and the general pollution of practically all supplies in the flooded areas. Past experience teaches that the death toll from impure water used by residents of the flooded areas will exceed deaths directly due to the floods.

The most effective emergency treatment in practically every case is, or includes, disinfection, for which chlorine is almost universally used. Equipment for applying chlorine effectively is an absolute necessity, and it is needed at once. To meet this need, the manufacturers of such equipment, evidencing the finest kind of public spirit, send units of their equipment on request, with very little consideration for the matter of payment; and they also contribute lavishly of their skilled sanitary engineers. Proportioneers, in a recent flood, shipped "on need" some twenty machines for chlorination, and are cooperating as fully in the present disaster. Wallace & Tiernan have 20 engineers and 30 emergency machines in the Ohio-Mississippi area. Doubtless other manufacturers also are contributing fully.

In the August, 1936, issue of PUBLIC WORKS was reported experimental work on light, portable filtering units, primarily for army water supply. Such units, if now available, would be of very great service in flooded areas. Groups of these, if assigned to the various state military or public health units and to the Red Cross, would supplement existing facilities which, despite the generous cooperation of manufacturers, are perhaps available in inadequate numbers.

Blessed Events

A new arrival in the Highway field, The Manual of Street and Highway Equipment and Materials, is expected within the next month or so. And shortly thereafter will appear the third of the Manuals of Sewage Treatment Equipment and Sewer Construction.

Despite the rather complicated names that these texts bear, the readers will find them, we hope, concise, direct and to the point. In this they would be living up to the reputation already made by the Sewage Manual which has gone through two previous editions totalling more than 8,000 copies, while the Water Manual, published last spring, has reached a circulation of 10,000. The first edition of the Street and Highway Manual (to give it a short title) will be 12,000.

The primary aim of these manuals was originally to emphasize the necessity for good equipment and good materials, and also to show the field and office man what there was available with which to do his work better. But so many uses for them have cropped up, according to reports from our readers, that the utility and value of these texts appear to have exceeded our expectations. They are being used for college texts; to replace, or simplify the use of, the customary bulky (and always incomplete) catalog file; as a sales book by engineers to illustrate the necessity for equipment in a modern plant; and they are in the brief-cases of hundreds of equipment salesmen.

We hope the forthcoming Street and Highway Manual will be of equal help in planning, designing, constructing and maintaining highways and streets. Half a dozen outstanding highway engineers have toiled with us to make it of maximum value; some 1200 catalogs have been consulted, studied and boiled down.

The new Sewage Manual will be rewritten and expanded very materially; and, since it contains no reprints, previously published matter, etc., it will be, also, strictly up to date.

What Cost Leaky Sewers

Sewers *can* be built water-tight, but few sewers are. If the latter statement is doubted, try to find a sewer plant operator who does not find more sewage reaching his plant in wet weather than in dry. Specifications for sewer construction often provide that the leakage shall not exceed 10,000 gpd per mile of sewer. Many instances are on record of leakage of ten or more times this amount —the sewers carrying as much ground water as domestic sewage. Of course, tight joints cost more, but!

A treatment plant costs generally from $150 to $300 per thousand gallons—say $200. Then eliminating 10,000 gpd of infiltration eliminates $2,000 of cost; and adding this $2,000 to the construction cost of the sewer gives 38 cts. a foot or $1.14 per joint of 3-foot pipe. Any engineer who does not know how to make tight sewers for half this additional cost had better read up on technical literature and advertisements. In addition to this saving in plant construction cost, we have saving in operating costs, in some cases pumping, chemicals, etc.

Not all towns have treatment plants, but the number is increasing rapidly; and when a town with excessive infiltration of ground water finds that the size of its proposed plant must be increased 50 to 100 percent therefor, the engineer who built the sewers will be given a lot of explaining to do. And the town will just have to put up with it; tightening a sewer which leaks in most of its joints is so expensive a proposition that it may be called impracticable.

Even if there is no treatment plant or pumping, a 15-inch pipe would be required to carry sewage plus 100,000 gpd. per mile of ground water where a 10-inch would be required for sewage alone. And if the sewer is not made large enough to carry the infiltering ground water, backing up through house connections may easily do damage many times the extra cost of tight joints over leaky ones.

We can see no excuse whatever for building leaking sewers in the future whatever there may have been in the past. (We built leaky ones ourselves 45 years ago.) It is just as necessary that every sewer should be tested for tightness as that every water main should. A thousand gallons of water leaking into a sewer costs 10 to 20 times as much as the same amount leaking from a water main.

Just let that sink in. Then lets make a brand new resolution never again to build anything but tight sewers.

FROM THE EDITOR'S CORRESPONDENCE

We are glad to answer any questions submitted by subscribers to help them solve problems arising in connection with public works they have in hand. Here are a few recent ones. We have answered all of these, but, as one of our correspondents says: "A combination of technical experiences surpasses that of any one individual. That, I take it, is engineering." Have any of you had any experience on which you can draw that may be of further help to the writers of these inquiries?

From Idaho: I would appreciate it very much if you could give me information as to where I can find an analysis of the cost of crushing gravel. I wish to calculate whether it would pay a county to invest about $16,000 in a crusher and power, or would be cheaper to have it done.

From Philadelphia: We are attempting to assemble data relative to the comparative cost of labor, skilled and unskilled, especially that used in sewer construction projects, for the years from 1928 to 1936.

From New Jersey: Will you kindly send me the name of the state college that has a correspondence course on sewage treatment plants, referred to in your December issue?

From New Jersey: I am partcularly desirous to determine the proper design for an outfall, and if it will be necessary to resort to pumping. For this reason, I would like to obtain a list of magazine articles and data that cover in some detail outfall sewers in flat sections which discharge into tide water creeks.

And here is one that explains how some of our small texts are being used.

From an equipment company: Answering the question in your recent letter, we have purchased the copies of "How to Design and Build Small Earth Dams" and "How to Design Retaining Walls," in order to provide our salesmen with that information. We believe that other companies furnishing highway and drainage equipment might do well to provide their salesmen with additional information for the convenience of their customers.

Extracts from other letters are also given below:

Living in Canada Has Some Drawbacks

To aid in designing a sewerage project for this municipality I should be pleased to receive data from firms supplying equipment for treatment and disposal plants; also concerning information obtainable by purchase (pamphlets or technical journals) on the latest practice in Imhoff tank construction. Am a subscriber to your excellent monthly and am taking advantage of courtesies offered." (The information was furnished and acknowledged with the following comments):

Appreciation is expressed for the information sent. Several companies have favored me with both catalogs and data, and the "Sewage Manual" sent will prove its undoubted value.

The overhanging fear one has, in the far Canadian West, is the cost of mechanical equipment with customs duties, freight rates, and "what have you" superimposed to a forbidding percentage. In the Los Angeles (So. California) district (where last in practice) such factors were among the lesser troubles, due to the Panama Canal.

Prerequisite data on the sewerage project (separate system) are being gathered and compiled. We have here the handicap of having to handle most of the trade wastes at the lowest levels. There is, however, an advantageous factor in an interlocking agreement now being consummated with the Dominion Government authorities who have 100% control (by check dams) of the feeder lake (6 x 90 miles) directly upstream from the city, whereby pumping will be intermittent and periodic.

Your articles on earthen dams and methods of gaining fill density showed to advantage in the construction of a semi-hydraulic clay core irrigation reservoir contracted this year by the corporation. Results in compaction are excellent. This unit, 1,325 ft. long and 42 ft. maximum depth, will be completed during 1937 at a cost of $60,000—$1.15 per cubic yard of embankment.—A. R. M., Corporation Engineer.

His "Old Swimming Holes" Are No More

The article "Creston Doubles Capacity of Its Reservoir" in the January issue of PUBLIC WORKS reminds me of my boyhood days. I finished the grammar school in Creston and left there in 1888, at the age of twelve, for the far west.

In those days people were not so particular about their water supply as they are today. I learned to swim in the mud holes of the stream that supplied water for that old reservoir and in the stream that took the overflow away. One Sunday a woman was drowned bathing in the reservoir itself.

One day a couple of large boys threw a smaller boy into one of our old swimming holes where the water was over the boy's head—and he could not swim! The small boy was a young tough, and I guess they thought that all young toughs could swim. We had an exciting time getting him out before he drowned, but we managed to rescue him after he had swallowed about a gallon of muddy water.

We used to fish for catfish in those streams; and, believe it or not, the second fish that I ever caught I didn't have any bait on the hook. The first one had swallowed the bait. It was——long. Now that isn't stretching it very much for a fish story, do you think?

Oh, yes! I have almost forgotten to leave enough space to ask for the index for the year 1936.—W. S. W., City Engineer.

Minnesota Willing to Try Iron Pavement

If promoters of iron pavement will share part of the expense, and St. Louis county will pay the balance, the Minnesota State Highway department is willing to give iron highway pavement a trial, according to N. W. Elsberg, state highway commissioner.

Replying to a request from a St. Louis County delegation that specifications be changed to permit iron pavement on a grade crossing elimination project near Eveleth, Mr. Elsberg said he would make such a request to the United States Bureau of Public Roads if convinced the test would be without cost to taxpayers of the State.

The project involves approximately 5,000 square yards of paving surface and the additional expense would be approximately $5.50 a square yard, or about $27,500. St. Louis County has appropriated $15,000 to test iron paving, due to the importance of iron mining in Minnesota. The project is approximately six-tenths of a mile in length. A short stretch of iron paving is now being tested on the University of Minnesota campus. Iron would undoubtedly have a longer wearing surface than concrete, highway engineers say. *Minnesota Highway News.*

Contractor's Indebtedness to an Equipment Company

The Kentucky Court of Appeals held, 262 Ky. 837, 91 S. W. 516, that a supply company which sold a tractor and leased equipment to highway contractors could apply payments made to it on an open account instead of on notes given for the purchase price of the tractor, where the contractors did not at any time give any instructions as to the application of the several payments. (Cundiff & McDowell v. Roy C. Wayne Supply Co.)

At left—Working with ladders on a group of cottonwoods. Notice how the lower growth has been removed first, and also the absence of stubs after the trimming has been completed.

Below—A tree butcher's masterpiece. The sign over the gate "Cottonwoods" will be replaced with one reading "Kindling, Yours for the Taking." These trees, about the most valuable thing on the property, are absolutely ruined and the only thing that can be done is to take them out.

At right—A properly trimmed young ash. It will be many years before this tree requires further attention. Note how carefully the natural shape of the tree has been preserved.

Roadside Development for Counties—III

Tree Planting on County Highways

By F. M. GUIREY

Landscape Engineer, Arizona State Highway Department

AND now, let's take a look into the subject of planting. About the first thing to say is—don't do too much out on the open road, where most of our work will be done.

When this type of work first started, most of the planting was done in formal rows, but we have got away from this practice for several good reasons. First, row plantings tend to get very monotonous. Second, in the inevitable tree loss that follows any planting, vacant spaces are much more noticeable than when informal groups are used. Third, many more trees are required in formal than in the informal group type, where long open intervals may be left which seem to close up from the perspective illusion as one drives down the road. Lastly, trees in natural conditions are almost never found in a continuous straight line.

Study your topography carefully. The summits of hills make good locations for the establishment of growth. Material here helps to break down the monotony of the sky line. Water holes offer chances in arid locations. A row or series of groups along a canal enhances the beauty of the landscape. Plantings near intersections should be carefully studied from the safety angle. Wye developments should be kept simple and open. There are times when a formal planting near the entrance to a town is effective. When shade trees are used for this purpose, staggering is advisable to keep the planting from getting spotty. Generally, low types of growth should be planted nearest the roadway, building up into higher types as the right of way line is approached, to afford a roadway that has a wide, open appearance rather than one that is cramped and narrow. This is an old, established principle that holds just as true today as it did hundreds of years ago in the layout of the world famous renaissance Europe. A transition of plant material should usually be employed at the end of a formal development, to keep it from suddenly hitting you in the eye like a totem pole on a snow bank. Also, the addition of a few trees to a plant row crossing the road breaks down its stubbiness, and blends it into the landscape.

Now another element enters the game. The problem of water and maintenance. If planting is done at random, you may find that irrigation costs will eat you up within a few years. Whenever possible, take advantage of locations where water is available—it will more than repay your trouble and search in years to come. Young trees, like young children, require a great deal of care, even under the best of conditions, and nothing on earth looks sorrier than a half-dead landscape project. Also, pick spots where soil is good. It will save you time and money in the importation of topsoil to give your growth a good start.

One of the major landscape problems is wires. Do not plant high-headed growth where it will be subjected to constant trimming in future years for wire clearance.

Planting in locations where loose stock is prevalent requires the placing of protective guards. This is not prohibitively expensive, but should be avoided.

The next thing of concern is what to plant, or rather, what not to plant. Following nature is one of the safest bets. The things that you find growing naturally in your locale are more liable to thrive than foreign plants. Furthermore, they fit in with the existing growth more pleasantly than do exotics. The planting of flowering, fruit or nut-bearing growth is questionable, for children as well as adults are liable to destroy what is set out in an effort to harvest the crop. Some trees are more susceptible to sun scald than others. Some are insect harborers and should be avoided. Others are subject to root rot or various forms of blight, or may even be disease carriers. Consultation with your own State landscape engineer and entomologist will solve most of these problems. The U. S. Dept. of Agriculture has published a number of farm bulletins that contain excellent advice as to the best planting bets in various parts of the country. Make the most of your own native stock, for though it may seem commonplace to you, some tourist may have traveled thousands of miles to see it, such as the giant cacti in Arizona. Imagine his embarrassment and disgust if, on arrival, he discovers the same thing that he has in his own back yard!

In the actual setting out of material, a few tried and proven rules may well be observed—with profit. Plant material should show a normal, vigorous growth. It should be free from malformations, such a split bark, ragged stubs of branches, cuts on the main trunk, or bruised or rotten spots. Roots should be cleanly pruned, show an open, uncramped growth, be free from fungus and dead spots, and above all kept constantly moist. Where balled evergreens are used, the balls should in all instances be uncracked—this is of utmost importance. Furthermore, the balls should be sufficiently large to eliminate severe root pruning. The north side of all trees should be clearly marked, so that when reset they will retain their original exposure to the sun. Some trees will require loose wrapping, screens, or painting to protect them from the sun, and usually stakes to protect them from the wind. This may involve a little more cost originally, but will repay itself thoroughly in the reduction of tree loss. The holes to be used for planting should be thoroughly soaked before use—anywhere from three to twelve hours in advance, depending on the location. Soil should be thoroughly loose below the holes to permit adequate drainage and prevent souring. Topsoil should be placed in the bottom of the hole, where it will be next to the roots; though mixing manure or other fertilizer with it should be done only upon the advice and within strict accordance of the recommendations of an expert. This last is important, because in many localities, such fertilizers cause overheating at the root system, with subsequent loss of the tree. The tree should be placed slightly below the ground level, to afford a basin for irrigation purposes. The actual level of the soil in the filled hole should be approximately the same as the tree's original soil level, or the tree will die. This is true even of old trees. Where a new fill is brought up around the trunk of an existing tree, unless an open well is made with rock or timber from the original ground line to the top of the new fill, the loss of the tree is almost inevitable. Basins sufficiently large for proper irrigation of the tree should be placed as soon as the planting has been done. These are usually from four to six feet in diameter. If these basins are a little below grade, rather than above it, side feeder ditches may be run to pick up rain water, and help irrigate the tree.

Immediately following planting, and sometimes during (according to the method used) water should be applied in sufficient quantity to allow for full settlement of the new earth in the hole, and to insure elimination of air pockets around the roots, which would cause later drying. The placing of a good mulch is essential in many localities to keep the moisture in the ground. It may be almost anything: rotted manure, straw, rotten leaves, cotton hulls, or what have you. It is a good idea to use something that will break down and decay by the end of a season, otherwise, it will lie on the surface and sour. This rotten mulch serves likewise in time as a fertilizer.

Cacti are the one exception to these rules. They should be moved bare root, left exposed to the sun to callous, and then planted in a sandy or gravelly, well drained soil, without any mulch or fertilizer. They require very little water, once they are set out. The prickly pear is one of the few that needs irrigation. (This is not a treatise by a cactus authority—for I'm not one. The above mentioned applies only to the common hardy varieties set out for highway planting, and is not arboretum procedure.) One other care must be observed in cactus moving. Do not bruise them—they are very tender, despite their many thorns, and rot easily. All bruised places should be immediately cut out, and if necessary, cauterized with a hot iron. Large specimens should be carefully guyed for about two years to prevent loss by windfall. And one final precaution—don't get stuck!

The fourth and final in this series of articles, entitled "Organization, Planning and Cost of Roadside Development for Counties," will appear in an early issue.

Closing Longitudinal Joint in Concrete Pavement

The Connecticut Highway Department has developed a method of drawing concrete pavement slabs together when the longitudinal joint has opened by side-slipping of one or both slabs. When this occurs there is invariably some settlement, and preparatory to closing the joint the slabs are mud-jacked to within 1 inch of grade. The transverse joints are then freed (if not already so) by means of a series of holes and a pavement breaker. The longitudinal joint is cleaned out by means of a pick plow drawn by a truck, small points permitting cleaning joint openings as narrow as ½".

Six large, strong hooks, each fabricated from two heavy sheets of steel, are used in pairs; each pair connected by a ⅝ inch cable threaded through a 3-pulley and a 2-pulley block, and placed on opposite sides of the pavement, with a wood block between hook and pavement to protect the latter. One pair of hooks is placed near each end of a slab and one in the middle, and the cable of each is attached to a truck about 100 ft. from the nearest end of the slab. With the slack taken up and an equal strain on all hooks, at a signal all three trucks pull and the slab is easily moved to the desired position. Where both slabs are to be moved toward each other, one is moved at a time, one hook of each end pair being hooked onto the longitudinally adjoining slab near the transverse joint.

Traffic does not have to be detoured during the operation, but is held up during the actual moving of a slab—7 minutes for a 60 ft. slab was the longest delay. During the 5 years this method has been in use the Department has used it on 112,365 sq. yd. The maximum opening corrected was 14 inches.

Mileage of City Streets

So far as we know, no information has ever been obtained by federal or any other agencies concerning the street mileage of all the municipalities of the country. We have often been asked for such information but know of no source from which it can be obtained. In fact, in our efforts to collect such data we have found numbers of municipalities which do not know how many miles of streets there are within their own boundaries.

Recently an estimate has been made by the National Highway Users Conference, based on data submitted by the American Road Builders Association and other sources, which we give below without making any conjecture as to its accuracy.

Cities having a Population of	*Number of cities*	*Population*	*Street Mileage*
100,000 and over	93	36,325,736	65,870
50,000 to 100,000	98	6,491,448	16,610
30,000 to 50,000	121	4,733,354	13,160
5,000 to 30,000	1,521	16,686,695	75,400
2,500 to 5,000	1,332	4,717,590	21,050
Total	3,165	68,954,823	192,090

Present Standard Practice in Separate Sludge Digestion

A COMMITTEE of the Sanitary Engineering Division of the American Society of Civil Engineers has prepared a comprehensive (although submitted as a "progress") report on standard practice in separate sludge digestion, which occupies 68 pages of the January "Proceedings" of that society. This includes discussion of (1) Characteristics of sewage and of the end products of digestion; (2) Environmental factors; (3) Types of digestion tanks; (4) Computations of tank capacity and heating requirements; (5) Methods of sludge disposal; and (6) Operating routine of sludge digestion. The committee consists of Samuel A. Greeley, chairman; W. L. Havens, C. B. Hoover, C. E. Keefer, and John F. Skinner. The following article is an effort to give in condensed form the most essential features of the report.

Characeristics

Well digested sludge is generally of uniform texture, black or dark colored, with no visual evidence of fresh sewage solids; with a moisture content of not more than 90% (but may have as much as 95%); odor faintly tarry, changing to earthy or musty after draining or drying; and drains readily on sand beds. Its mineral content is substantially greater (expressed as percentage) than that of fresh solids; volatile matter 50% or less of that of fresh sludge; as removed from drying beds the organic content seldom exceeds 50%, with a BOD content substantially lower than of fresh solids, and a pH between 7.0 and 7.6. The fertilizer value of digested sludge is about 1/3 that of undigested.

Composition of digestion gas averages about 69% methane, 22% CO_2, 6% nitrogen and 3% hydrogen; heat value 730 Btu per cu. ft. The higher fatty acids of grease produce more than their equivalent weight of gas. Amount of gas from heated tanks, 0.6 cu. ft. or more per capita per day; less from unheated. From an activated sludge mixture, an average of 0.69 cu. ft. Certain industrial wastes may increase this.

Most important factors are temperature of sludge, pH, percentage of return sludge (reaction and seeding), and trade waste content; less important are pressure and density.

Temperature. There are some indications that a temperature of 110° F. to 130° F. gives a shorter digestion period than lower ones but there are not enough operating data from large plants to confirm this. "Present information indicates that temperatures between 80° F. and 95° F. are desirable."

Among considerations in selecting operating temperature are: (1) Balance between cost of providing extra capacity for digestion at a lower temperature and that of extra equipment for heating and insulating to maintain a higher temperature, with due consideration of the value of the additional gas. (2) Capacity of the selected type of tank for being heated and retaining heat. (3) Method of heating and rate of transmission of heat. (4) Effect of temperature on rate at which sludge cakes on heating coils. (5) Effect on the heat balance of the concentration of solids in the tank sludge and in the fresh sludge. (6) Heat lost with the sludge liquor and the possibility of some recovery by heat exchange. (7) Effect of more active gas release on the area and depth of the tank and on formation of scum. (8) Need for and relative cost of winter storage. (9) Total size of sludge digestion and storage tanks is not directly proportioned to time required for digestion. (10) Effect of the duration of low winter temperatures on relative costs of operation at different temperatures.

Acidity of sludge delays digestion. Solids become acid when there is not enough ripe sludge present, as when tanks are first started, when ripe sludge is lost by improper operation, or when acid industrial wastes are present. More ripe sludge is the best remedy; lime may be used under abnormal conditions but is not recommended for normal operation, unless for neutralizing acid trade wastes. Seeding sludge must be neutral or slightly alkaline.

Diagrams (a) and (b) are used for selecting value of K (ratio of volume of liquid sludge added daily to the volume of sludge in the tank), (a) for heated and (b) for unheated tanks, when V (volatile fraction of solids) is ½ or is ⅔, for various percentages of volatile solids digested, and for various water content ratios (1 minus percentage of water in withdrawn sludge, divided by 1 minus percentage of water in entering sludge).

Diagrams (c), (d) and (e) are used for determining the theoretical capacity of tanks, in cubic feet per pound of dry solids added daily, for various values of V and of percentage of volatile solids digested; (c) being used when sludge is to be withdrawn daily, (d) for periodic withdrawals and incomplete digestion, and (e) for unheated tanks in cold climates, necessitating winter storage.

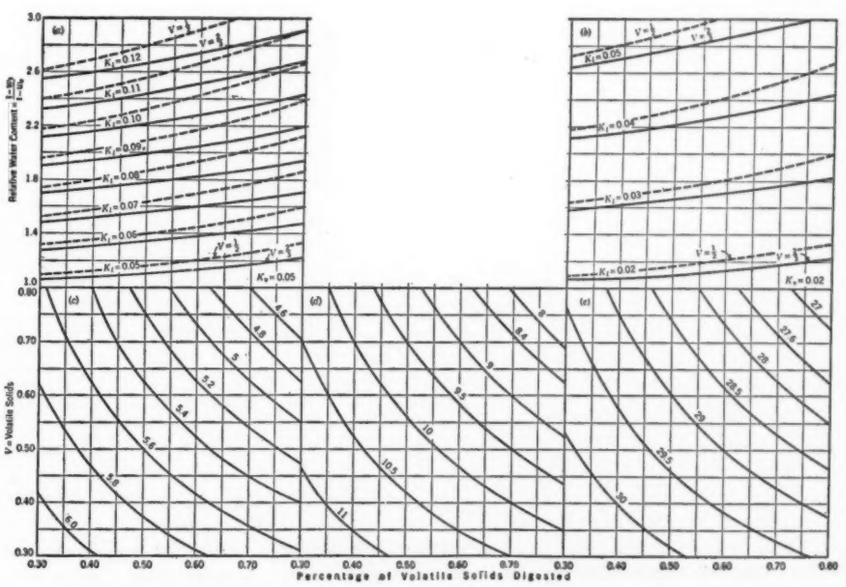


Diagram for determining theoretical capacity of sludge digestion tanks.

Pressures likely to obtain in practice appear to have no effect on bacterial action causing sludge digestion, or on digestion time, or on the quantity of gas drawn off with the supernatant. Negative pressure does not produce more gas or have any effect on digestion or tank effluent.

Moisture content of sludge has little if any effect on rate of digestion.

Types of Digestion Tanks

Concrete tanks have many advantages over the less expensive earth tanks—permanence, space economy and adaptability to requirements of operation and structural design. Open concrete tanks for storing digested sludge during the winter cost only 1/3 as much as covered controlled tanks.

Covered tanks retain heat and so promote bacterial activity; keep scum submerged, thus accelerating digestion of floating solids; permit collecting gas, and control odors.

Multi-stage digestion has been adopted by 30 or more cities in the United States. Approximately 90% of the digestion is said to be accomplished in the first stage. The supernatant from the second stage is relatively clear.

Pumping sludge is effected by use of air lift, pneumatic ejectors, diaphragm pumps, reciprocating pumps (using either ball valves or metal flap valves), or centrifugal pumps. The last are preferably single-suction, enclosed-impeller, with speed not exceeding 720 rpm.

Gas explosions in covered digestion tanks are a very real hazard, adequately prevented by use of floating covers. With fixed covers, the gas dome should be connected to a gas holder.

Sludge heating is effected by use of gas from the digester, heat being introduced to the sludge by (1) circulation of heated water by means of a closed system through coils of pipe in the digestion tank; (2) discharge of heated water or heated sludge liquor directly into the contents of the tank; (3) preheating of the sludge before its discharge into the digestion tank; (4) circulation of sludge through a separate tank equipped with heating coils.

Computation of Tank Capacity

Capacity of a sludge tank is best stated in terms of the weight of solids in the sludge removed daily from the sewage, rather than in cu. ft. per capita or per mgd of sewage.

Rational formulas for capacities of sludge tanks under several typical conditions are given and explained in detail in the report. These involve the use of more than 40 symbols representing variables, and are too voluminous for reproduction here. It may be useful, however, to give a number of results obtained for different conditions.

The first of these assumes a tank to which a given weight of solids is added daily and in which an equal weight disappears daily by digestion and withdrawal (including those in the supernatant); 50% of the volatile solids are digested in 30 days, the volatile constituting 2/3 of the total solids; population 100,000; 10,000 lbs. of solids added daily; dry solids in the sewage, 120 ppm; sewage flow 10 mgd; mean percentage of water remaining in the tank, 92.5. Theoretical required net capacity of sludge tank 53,000 cu. ft. Increase depth 3 ft. for scum and supernatant, giving (for two 40′ tanks) 60,800 cu. ft. for a controlled tank under ideal conditions.

Assume the same conditions, except that sludge is drawn only once in 15 days, and the net capacity becomes 72,000 cu. ft. (the period required to reduce the volatile solids by 75% being taken at 45 days); but if sludge is drawn once in 30 days the net capacity becomes 84,000 cu. ft. The last two cases give incomplete digestion; but complete digestion can be obtained with 84,000 cu. ft. if sludge is drawn once in 15 days.

Assuming an unheated tank in a cold climate, with 60 days of suspended digestion, other conditions as in the third case above, and the necessary net volume becomes 276,000 cu. ft.

These give per capita net capacities of 0.53, 0.72, 0.84 and 2.76 cu. ft. respectively. Add to each about .07 to .15 to allow for scum and supernatant.

Computation of Heat Requirements

Generally the quantity of gas produced by digestion averages 0.5 to 1.0 cu. ft. per capita per day, or 5 to 19 cu. ft. per lb. of volatile solids added daily to the tank. This can be estimated to furnish about 700 Btu per cu. ft. of gas. If we assume 2/3 of the solids to be volatile and ¾ of the volatile to be digested and yield 12 cu. ft. of gas per pound, and 60% efficiency of utilization of the gas, we have 2,520 Btu per lb. of solids added available for heating the tank.

The heat losses by conduction and radiation through the roof, walls and bottom of the tank, and heating of the incoming sludge, are to be balanced against this. In an example given, a tank 40 ft. diameter, 24 ft. high, banked with dry earth, roof 8″ concrete, wall 18″ concrete, floor 12″ concrete located below water table; temperature of sludge 82°, mean annual temperature of sewage 56°, of air 50°, of earth 60° and of ground water 54°; then the heat required is but 35.4% of that furnished by 4,000 pounds of solids per day. If the tank wall be 6″ thinner the loss through it would increase 24%.

Operating Routine

In putting digestion tanks into operation, use of seeding material is not necessary but will generally hasten normal digestion, especially in winter. The quantity of seeding material usually ranges from 20% to 40% of tank capacity.

Fresh solids should be added continuously or at frequent intervals, at rates not exceeding 3% to 5% of the solids in the tank, based on volatile content.

The optimum pH value for any particular plant must be determined by experiment. Use of lime should not be necessary if tanks are properly operated, unless to neutralize unusual acidity of the sewage.

There is considerable difference of opinion as to the advantages of stirring sludge. Advantages claimed are that it releases the gas at a uniform rate, promotes digestion by helping to maintain a favorable reaction, mixing chemical reagents if added, and assisting in distributing raw sludge through the tank.

In drawing sludge, it should be allowed to flow at a slow regular rate, to prevent formation of channels and withdrawal of partly digested sludge.

Heavy layers of scum may cause odors and prevent free discharge of gas, but may persist for long periods without affecting tank efficiency. Excessive formation may be prevented by submerging racks or stirring.

The accepted practice for controlling foaming is the withdrawal of sludge from the tank and maintenance of proper quantities of good seeding material.

It is more effective to avoid conditions that produce odors than to control the odors themselves. Such conditions include accumulations of sewage solids and grease on the tank walls or walks or about the grounds. Hydrogen sulfide odors may be controlled by use of liquid chlorine.

Reservoir Construction Effects Saving in Purification Costs

By J. D. SMITH
Superintendent, Cheraw Water Works

CHERAW, S. C., until this year used as a settling basin, in connection with its filtration plant, a reservoir built 23 years ago with a capacity of 800,000 gallons (about two days' supply), which is entirely inadequate for clarifying the water pumped to it from the Great Pee Dee river without heavy dosing with coagulants; to say nothing of the worry and anxiety to the superintendent when water was low in the river or something went wrong with the pumping machinery. In the fall of 1936 a new reservoir was completed with a capacity of something over 2,000,000 gallons.

With the new reservoir completed, we are using both it and the old one as settling basins and are able to reduce our chemical dosage by 40 to 50 per cent and still secure more complete sedimentation, thus putting less burden on the filters and effecting considerable saving of wash water as well as producing water of better quality. The practice now is to apply the chemicals to the intake from the river at a point about 400 ft. from its outlet, thus affording a thorough mixing with the water before it is delivered to the reservoir. Entering the new reservoir, the water flows slowly through its entire length, across into the old reservoir and through its length, and then flowing to the filters.

This reservoir was built by the WPA, entirely by common labor with picks, shovels, wheelbarrows and wooden tamping blocks; the only machinery used on the job being a small concrete mixer. It gave about a year's work to approximately 100 men who would otherwise have been unemployed. The labor and cement were supplied by the WPA, while the town furnished the sand and gravel, and the pipe, valves and fittings, which were installed under the supervision of the author.

A part of the same project, as yet unfinished, is a clearwater storage reservoir of 250,000 capacity, which is being constructed below the level of the filters and requires considerable excavation, on which also no machinery will be used except the concrete mixer.

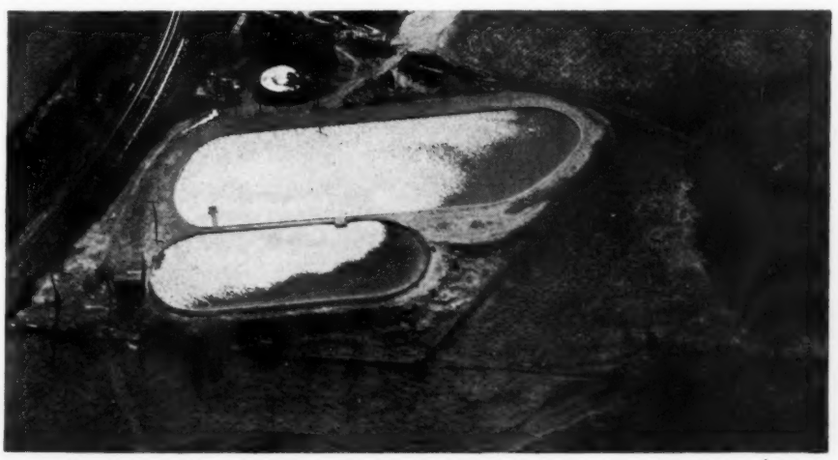
All of the above was conceived, planned and commenced by a former mayor and council, only one of which was re-elected (the others did not "choose to run"), but the succeeding council and mayor E. G. Ingram have carried out the project in a whole-hearted manner. The work was done under the supervision of J. A. Teal, WPA district engineer, and Gilbert C. White & Co. of Durham, N. C.

An Unusual Experience in a Chlorinating Plant

By Robert E. Phaneuf, Superintendent of the Water Dept., Palmer, Mass.

One morning while in the chlorinating house I heard water dripping and, opening the trap door leading to the diffuser, found water to be spurting from the 12-inch cast-iron main under an improvised clamp around the pipe. Removing the clamp, I found a hole in the main 12 inches long by 4 inches wide between two 12-inch gate valves, which apparently had been caused by chlorine bubbles breaking against the pipe. I closed both gates but water still escaped from the hole. Investigation showed that the seat of the valve on the up-stream side also had been eaten, apparently by the chlorine.

It seemed useless to replace the pipe and valve with the same materials, so the dealer from whom the chlorination equipment was purchased was asked for advice. He stated that either rubber or cement would resist chlorine and I decided to wrap the 12" pipe with a sheet of rubber and clamp it in place with a Skinner clamp. As these are not made longer than 12 inches, a 12" and a 6" clamp were electrically welded into one 18" long. After placing the rubber all around the pipe and clamping it in place, I tapped through clamp, rubber and 12" pipe at a 30° angle from the top of the pipe, for installing the corporation for the diffuser



Airplane view of old and new reservoir, and at the right, J. D. Smith, Superintendent of the Cheraw plant.

stem; the object being so that the chlorine bubbles entering at night, when consumption is low, would strike the rubber rather than the cast-iron pipe.

Had it been possible to remove the defective pipe without draining the reservoir (which was impossible because of the leaking valve) we would have replaced it with transite pipe. This did not seem to be practicable. But as the repair described was made over a year ago and no more trouble has been experienced, nothing further has seemed necessary.

Selling Water Softening to the Voters

NEENAH, WISC., needed water softening, but the majority of the citizens did not know it. The water supply (from wells) had a hardness of 70 grains per gallon. It was unsatisfactory for industrial use, but the citizens were accustomed to it, and in 1932 voted 2 to 1 against changing to purified water from Lake Winnebago, which had a hardness of about 10 grains per gallon, largely calcium and magnesium.

A committee of citizens who were persuaded of the importance to the city of a softer supply decided on a campaign of education, which was continued for seven months preceding an election in April, 1936. So effective was this that the vote then taken was 4 to 1 in favor of the lake supply's proving that the people are fair-minded and that their prejudices can be overcome with the proper education along psychological as well as technical lines. How this was brought about was told by S. F. Shattuck in a paper before the Wisconsin Section, American Water Works Assn.

The committee first installed on a main street an experimental plant treating 240 gpm of lake water, with an operator who was a good salesman. The State Board of Health and the press cooperated. In every way possible the public was informed about coagulation, chlorination, filtration, lime softening, use of activated carbon and other details. Talks were given before groups and organizations—civic clubs, schools, churches and social organizations, at which places samples of water from other supplies were exhibited. Examples of clogged pipe from the local supply system, and demonstrations as to the saving of soap and many other examples showing the disadvantages of the local water and the definite advantages of the proposed treated lake water were shown. From time to time business men were interested and had store window displays, and amateur cartoons were produced and exhibited. One of the most effective things was washing machine demonstrations, using water from the experimental plant coupled with demonstrations using the regular supply water. It was quite common, when talks were being made before the various organizations, to serve water from the experimental plants at the dinners and luncheons so that the people could see that it was a very satisfactory drinking water. During the home show, which occurred in Neenah during the campaign, a booth was provided at which detailed explanations were made of the advantages of the proposed supply. The newspapers were given weekly releases and the open forum was used and proved to be a very effective medium. A coffee concern had done considerable research work on the water from the experimental plant and a report of this concern's findings was published in the newspapers.

The news stories used covered such topics as to where the well water was obtained, how the natural filtration and purification resulted, with some indications of the hazards of natural filtration, and statements as to how man-made processes improved on nature's methods. Information was given as to what waters can be softened by the lime process and why—as well as a simplified statement as to what constitutes hardness and how it is measured and what the different kinds of hardness are. A detailed description of the use of activated carbon was written in story form showing what it does to taste and odors, and how it does it.

Articles in the open forum by the younger men of the community as to what a safe all-purpose water would mean to them were printed. Comparison of recent building statistics in Neenah with statistics from the neighboring cities after they had all-purpose water showed that Neenah was operating under a handicap due to its water supply. Articles were printed showing the cost and the nuisance of cisterns and double plumbing systems, as well as interesting stories from citizens who had lived elsewhere giving their experiences and impressions of the local water supply. Other articles, including an analysis of the consumption of water in Neenah, as well as published letters from laundries, engraving companies, building supply men and others showed the annual penalty of doing business in Neenah. Some citizens were actually found who had passed up Neenah when building their homes and had gone to some of the surrounding communities.

In order that all people would get an opportunity to see exactly what the water from the experimental plant looked like and how it tasted, free samples of three-gallon bottles, were delivered daily in those neighborhoods where it was felt that the greatest prejudices existed. Business men of the city interested themselves in the matter and supplied endorsements favoring the use of the surface supply as contemplated, as compared with the present supply.

Six months of education gave the people all the facts, but the committee believed that the situation called for an emotional charge. This was achieved by assembling all vital information in a pocket sized booklet and recruiting a district committee of 72 men and women to personally place a copy of this booklet in the hands of every family. At the same time opportunity was given every resident to register his or her name on a petition in favor of the proposed change. This house to house campaign proved to be the needed spark-plug and resulted in the elimination of many of the objectors. Finally, and just prior to the election, the citizens' committee issued a statement thanking the community for their open minded attitude and expressing confidence in the result.

Easement for a Water Pipe Line Does Not Include Duplicating It

A city which has express grants of easements to lay, construct, operate, inspect, repair and perpetually maintain water or conduit lines through and over a property has the right to enter the propery for the purpose of replacing, repairing, and maintaining the original pipe line. And this right is not lost by nonuser. But, the Virginia Supreme Court holds, **City of Lynchburg v. Smith,** 186 S. E. 51, the use of such an easement is confined to the terms and purposes of the grant. And the city, which had constructed a 30-inch wooden pipe line, was held not entitled to construct a new pipe line parallel to the original line which would require about 6 feet additional land and to abandon the original line.

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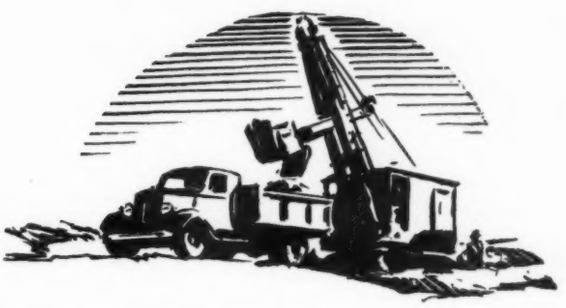

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A 1½ cu. yd. clamshell bucket raising refuse from storage pit to charging bin.

Conveyor removing ash over a screen to be deposited in ash hopper in the yard.

THE construction of a new refuse incinerator at Providence, R. I., was preceded by two years' study of the problem under the supervision of Charles A. Maguire, commissioner of public works, and Philip J. Holton, Jr., mechanical engineer. The idea at the start was to redesign the existing incinerator and provide boilers and turbo-generators for utilizing the waste heat of the incinerator to create power for use by municipal departments or sale to the local power company. However, the power surveys and tests proved definitely that the old incinerator could not be converted to produce power except by redesigning the combustion chambers and altering the building at a cost far exceeding that of a new plant. Moreover, refuse collections were continually increasing in volume and already exceeded the designed capacity of the plant. It therefore was decided to design a complete new incinerator of adequate capacity, with waste heat boilers and turbo-generators, and to place it in a new location adjacent to the new sewage treatment plant, where it could furnish power for operating this with a minimum of line losses.

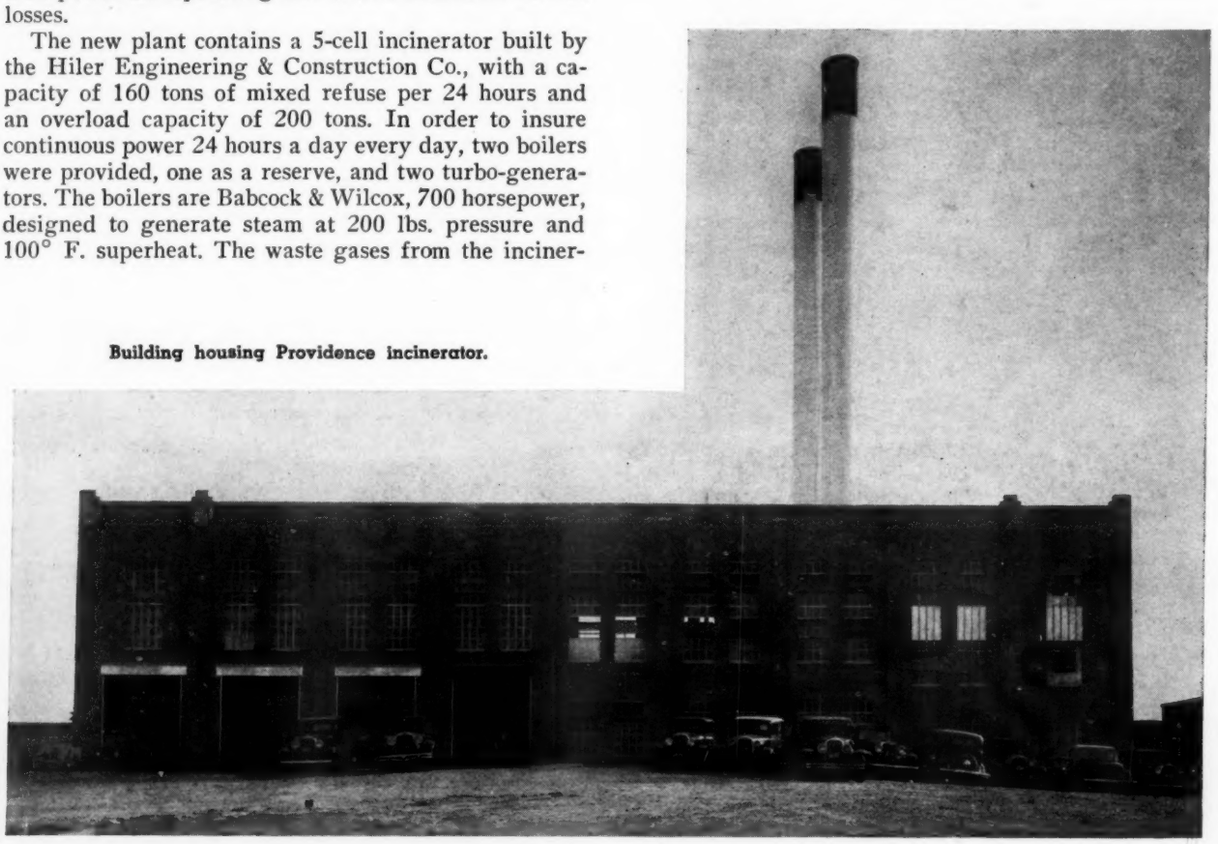
The new plant contains a 5-cell incinerator built by the Hiler Engineering & Construction Co., with a capacity of 160 tons of mixed refuse per 24 hours and an overload capacity of 200 tons. In order to insure continuous power 24 hours a day every day, two boilers were provided, one as a reserve, and two turbo-generators. The boilers are Babcock & Wilcox, 700 horsepower, designed to generate steam at 200 lbs. pressure and 100° F. superheat. The waste gases from the incinerator, with an average temperature of 1,450° F., can be conducted to either of the boilers.

The boilers operate 1,250 kw turbine generators. The sewage plant at present uses 750 kw per hour, but when the old steam pumps have been replaced with two 60 mgd and two 40 mgd motor-driven pumps, these also will be driven by these turbo-generators.

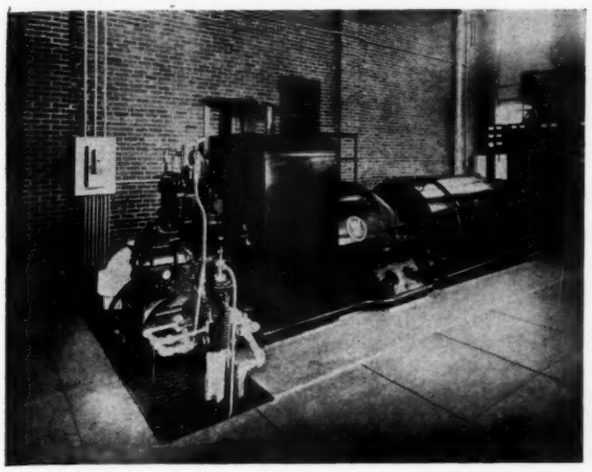
The plant is housed in a building of brick and steel, with architectural features of pleasing appearance.

The refuse, consisting of wrapped garbage and rubbish, is collected by trucks which discharge it into a 1,000 cu. yd. storage bin inside the building. This bin provides ample storage capacity to permit charging the incinerator at the rate giving maximum efficiency and also accumulating refuse for burning over week-ends, when no refuse collections are made.

The hoppers are charged periodically, to maintain



Building housing Providence incinerator.



One of the two 1250 kw turbine generators used in the Providence plant.

proper furnace temperatures, by means of a Westinghouse-equipped electric crane with a 1½ cu. yd. clamshell bucket which lifts the refuse 39 ft. from pit to charging bin. Preheated air for combustion is supplied under the grates by a turbine-driven forced draft fan. The ash falls from dumping grates into a water trough conveyor, which carries it up out of the water over a screen to an ash hopper in the yard, from which it is removed by truck.

Winter Operation of Sewage Plants

The following suggestions for winter operation of sewage treatment plants are given in "The Digester," published by the Illinois Department of Public Health.

Chain flight settling tanks: The application of heavy tractor oil to the chains has been found to eliminate ice formation which frequently causes chain breakage.

Floating cover digesters: A little ice cream salt scattered on the surface of the narrow ring of scum between the wall of the tank and the cover is helpful in preventing ice formation at this point.

Where the overhead gas line is used with this type of cover, a water connection for back-flushing the line combats freezing of condensate, according to Burgeson (Geneva).

Imhoff tanks: Frequent attention to gas vents will circumvent freezing. Don't let a thick layer of scum accumulate.

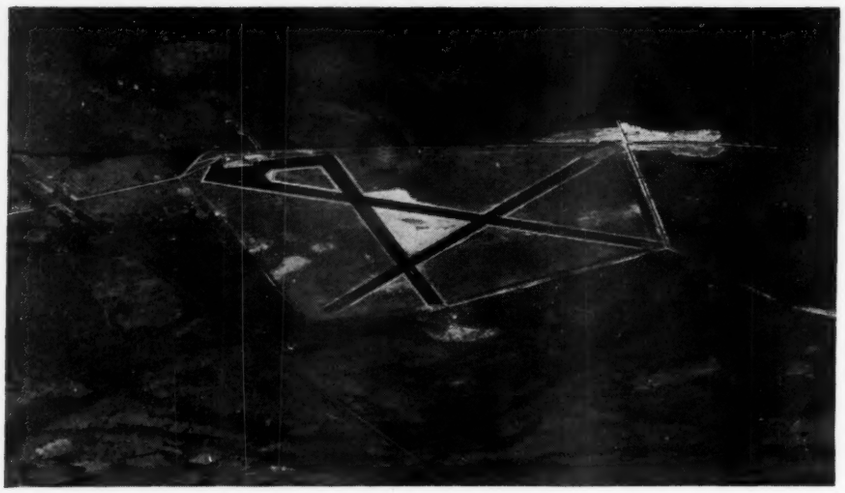
Mechanical aerators: Hofland (Dwight) has found that covering this type of unit with a plank roof in winter eliminates ice trouble and does not interfere with purification.

Corr (Woodstock) suggests painting vane type aerators with heavy tractor oil to serve the same purpose.

Trickling filters: Covering dosing tanks with a plank roof to prevent freezing of the siphon piping is done to good advantage at a number of plants.

Corrington (Clinton) offers that closing two or three nozzles at the outer end of revolving distributor arms will eliminate the ice ring around the edge of filters of that type.

Sand filters: Schacht (West Chicago) advises the use of just enough filter beds to give a rest period that will give no more than a slight freeze between doses.



Charleston airport, from 6,000 ft. elevation—photographed by Dexter Martin, of South Carolina Aeronautics Com'n.

By J. H. DINGLE
City Engineer, Charleston, S. C.

Charleston Modernizes Its Airport

IT IS stated on reliable authority that the Charleston, S. C., airport has fewer "fog-hours" per year than any other port on the Atlantic seaboard. This, combined with its geographic location and its highly developed rail, highway and air connections, gives it a strategic position from an aviation standpoint. To take advantage of this, the city has employed every means to bring its municipal airport up to the highest standard.

Beginning in 1928, the city acquired a tract of 432 acres situated 10 miles north. This land had already been cleared, so the principal preliminary work consisted of removing a few remaining trees and brushes from the 215 acres to be occupied by the landing field proper. As the land has an average elevation of only 13 ft. above sea level, and as rainfalls of 12 in. in 24 hrs. have been recorded in recent years, thorough drainage presented some difficulties, but was imperative for maintaining an all-weather landing surface. This first year one particularly swampy spot was eliminated, using 800 ft. of 10″ Armco perforated pipe.

To better accommodate the increasing numbers of commercial transport and private planes, and those of the Army, Navy and Marine Corps, the city in 1930 regraded a large portion of the field, involving 50,000 cu. yd. of excavation, laid 2,000 ft. of drain pipe, and installed sufficient new lighting equipment to completely modernize the lighting facilities of the field.

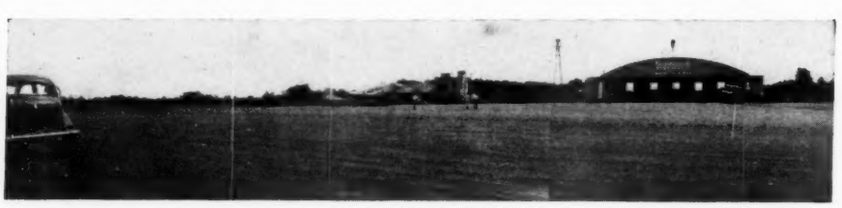
Further improvements were made when the WPA in 1935 provided funds to build and surface runways. These improvements carried out in 1935-1936 involved excavation totaling 60,000 cu. yd. The runways completed consisted of three with lengths of 4,000 ft., 3,500 ft. and 3,000 ft. respectively, also 1,000 ft. of taxi strips; all 150 ft. wide and surfaced with plant-mix sand asphalt 5½ in. thick. The 4,000 ft. runway was constructed in order to furnish facilities for a blind flying approach system suitable for any type of landing, the others for general use.

In addition to and connection with the runways, a thorough system of drainage was installed, calculated to remove the run-off from the heaviest rains within a period of 30 to 40 minutes. The water so removed had to be carried to an outlet by four miles of outfall canals 4 ft. wide at the bottom and from 10 ft. to 40 ft. at the top, and from 4 to 12 ft. deep.

In carrying out the more comprehensive drainage, it seemed desirable to relay the 800 ft. laid in 1928 and the 2,000 ft. laid in 1930. All this pipe (plain galvanized Armco) was found in such an excellent state of preservation that there was no doubt as to the desirability of relaying it, along with 21,650 ft. of asphalt-coated Armco perforated pipe, of which 400 ft. was 18″, 3,550 ft. was 15″, 6,300 was 12″, and 11,400 ft. was 10″.

Interceptor drains were placed along both sides of each of the three runways and of the taxi strips. The

Above: Installing perforated pipe along the runways.



Left: Administration building and hangar, Charleston airport.

pipe was laid on a bed of pea gravel at an average depth of 4 ft. and entirely surrounded with the same material. From the top of the pipe to the ground surface 1½ in. crushed stone was used to receive surface and intercept ground water. Approximately 8,500 tons of gravel and stone were used for this purpose.

The total cost of the project was $240,000, of which approximately $100,000 was expended for labor and the balance for materials and rental of equipment. An average of 200 men were employed for a period of one year. The project was financed by funds from WPA, the city of Charleston, and Charleston County.

At present the field is in perfect condition from the standpoint of surfacing, drainage and lighting, and is commented on favorably by the many pilots using this field. It is quite probable that during 1937 the Charleston airport will become the western terminus of a regular trans-Atlantic passenger service.

The airport is leased and operated by The Hawthorne Flying Service, but is also used regularly by Eastern Airlines and Delta Airlines.

The following personnel was responsible for the design and construction of the Charleston airport. Jas. Needle, assistant city engineer; John Richardson, general superintendent; John E. Macdonald, district engineer for WPA; Truman Miller, of the engineering force of the U. S. Bureau of Air Commerce; Dexter Martin, director of aeronautics State of South Carolina; and the author as city engineer.

Snow Handling in Minnesota Cities

Several cities of Minnesota, population 6,000 to 21,000, reported to "Minnesota Municipalities" their methods of handling snow and equipment used.

As to equipment, Crookston (6,000 population), uses a Diesel auto patrol grader equipped with a one-way snow plow; the heel of the blade of a grader is used to rip up ice and packed snow. Twice last winter the country highway department broke through large drifts with a big V-type plow.

Ely (7,000) uses its motor equipment—a 10-ton tractor, two 2½-ton trucks and a 3½-ton relay truck—equipped with one-way blades for light snow, and the relay truck and tractor with V-type plows for heavy snows. Sidewalks are plowed with horse-drawn plows.

New Ulm (8,000) uses a motor patrol equipped with a V-type plow and scarifier. For snows too heavy for this, a 60 h.p. crawler tractor equipped with a V-type plow and wings is hired from a local contractor. A horse-drawn plow cleans sidewalks. Several dump trucks are used for removal from business districts, schools, etc.

South St. Paul (11,000) uses three one-way blades mounted on 2-ton trucks, a 75 h.p. crawler tractor equipped with V-type plow with wings, and a motor patrol on pneumatics, tandem dual driver, for scarifying and blading ice and packed snow.

Virginia (12,000) has available a 5-ton and a 3-ton dual rear wheel truck and a 2½-ton single wheel truck operating plows with a 10-ft. wing spread for normal snows; and a 30 h.p. tractor for heavy snow falls and drifts. Sidewalks are plowed with a 20 h.p. tractor pushing a plow with 6-ft. wing spread. A 7-ton street flusher is used for blading streets and pulling 10-cu. yd. snow sleighs. A 20 h.p. portable upright boiler is used for thawing frozen storm sewer, culverts and catch-basins.

Austin (13,000) uses 2 one-way truck plows and a one-way crawler-type plow. A grader and scarifier are used in the business section.

County Highway Maintenance Methods and Organization*

By H. G. SOURS
County Engineer, Summit County, Akron, O.

IN GENERAL, highway maintenance involves doing the things necessary to keep the road as nearly as possible in its original state. When we change or improve the type, then we enter the field of betterment, involving resurfacing and reconstruction. However, because practically all county maintenance departments do both classes of work, this report will be made to cover both of them.

Organization

In most counties where funds are available, an engineer is in charge with a superintendent handling operations. This seems highly desirable and should be further broken down to district superintendents with gang foremen operating under them. A combination of the gang and patrol system seems to be the most practical plan, conditions governing the extent of each. The patrol works well for blading and dragging untreated roads and light patching of bituminous surfaces; while for hard surface patching, ditch and shoulder work, the gang plan is generally used and seems to be the most practical.

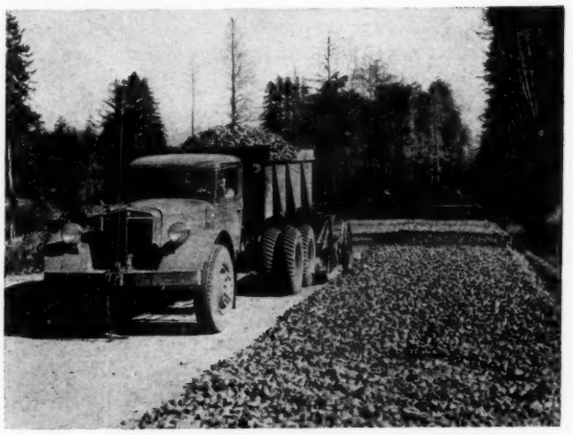
It is desirable, where a sufficient amount of work warrants it, to have some specialized floating gangs, such as bridge repair gangs, centerline and route marking, and guard rail gangs. A special patrol during the spring and fall and such other periods when damage is liable to be done to the roads, is oftentimes justified because it locates and repairs minor damages which might quickly result in something more serious.

The majority of the counties have their area divided into districts. Where possible they have district headquarters, garages and yards. This is very desirable, in that it centers activities in each district and eliminates a considerable amount of wasted time and expense involved when operating out of one central headquarters. In most cases, however, the repair and overhauling of equipment is done in a central headquarters, with emergency repair work sometimes done in the district garages.

Operations

There seems to be considerable variation in the number of hours worked per week. The eight-hour day perhaps applies to the majority of the counties, although some of them go as high as nine or ten hours per day. Very few counties work less than five and some work six days per week. It is to be noted that the 40-hour week prevails around the large industrial centers and the hours per week are the highest in some of the remote and rural sections. The local condition with respect to unemployment is no doubt reflected in the number of hours worked on the roads. The six-hour day, now in effect in many industries, does not seem practical in road maintenance on account of the scattered nature of operations, and particularly in the north where the seasonal conditions require certain things to be done in a limited length of time.

No indication of uniformity has been found in the matter of reduction of activities during the winter season in the northern counties. Some reduce hours per week, some maintain the same hours and reduce forces, some do both, and a few continue the same schedule throughout. In the southern states they are able to maintain uniform working conditions throughout the year.



Spreading stone on Salmon river cut-off.

It is difficult to make recommendations on these particular phases on account of widely different governing factors and conditions. Generally speaking, however, it would seem that the eight-hour day and five-day week would be practical in densely populated counties and industrial centers. This keeps the men off the road on Saturday when traffic is heavy and does not seriously conflict with industrial schedules of working hours. In the rural counties, where labor and employment conditions are different, as well as traffic, longer hours may be justified. As to winter reduction, conditions again have considerable bearing. Where unemployment is not serious, it is better to lay off men and maintain the hours. On the other hand, where unemployment is a serious problem, there is considerable justification in shortening the number of hours per week and to keep the forces more nearly intact.

Force Account Versus Contract

Practically everything which is classed strictly as maintenance is done by force account. It is where we get into the field of resurfacing and reconstruction that we find a difference in opinion and in practice. In the majority of cases, the application of bituminous materials in surface treatment work is done by contract, although there are some counties which are equipped with facilities to do their own applying. Many engineers prefer to do everything other than the application by force account, stating that they can do the job better and cheaper. Others say that they do not want to equip themselves for this class of work and can do cheaper and better work by contract.

There is something to be said on both sides of this question. When light treatments are being applied, the desirable plan would seem to be to contract the furnishing and application of the bituminous materials and to do the sweeping and the spreading of the cover material by force account. On resurfacing work, it

*A report at the Thirty-fourth Annual Convention of the AMERICAN ROAD BUILDERS' ASSOCIATION

When you need special information—consult the *classified* READERS' SERVICE DEPT., pages 59-61

would seem that the properly equipped and trained contractor should be able to handle the work more satisfactorily, considering everything.

It is reasonable to assume that in many cases where counties have been doing their resurfacing work by force account, they have established this practice by reason of the fact that considerable experimentation has taken place, resulting in changes being made during the construction, which are more or less inconvenient to handle by contract. As a result of this, many of the county organizations have become quite proficient in this class of work, and in those particular counties, contractors have not had the opportunity to develop trained organizations to handle the work.

In the case of plant mixes, it is hard to conceive that any county would be justified in owning and operating a plant of their own and this work should be done by contract.

Equipment

Practically all counties own their own equipment except certain heavy pieces such as power shovels and cranes, which are rented occasionally. The same applies to the renting of trucks, which is occasionally done when an unusual amount of hauling has to be done in a short time.

A wide variance of opinion seems to prevail on the size of trucks, but in general the most used among the newer trucks is in the two-ton to three-ton class. There are definite uses, however, for the smaller as well as the larger units. The majority of the engineers favor the trading in and replacing of equipment before heavy repairs are involved.

Hard-Surface Types

The practice with respect to repairs of the various hard-surface types seems in general to be to do the necessary patching with the same type of material as was incorporated in the original pavement. This practice is recommended and should not be deviated from with the exception of emergency work, where cold-patch material may be used on practically any type. The same thing might be said about using a different type of patching material in the case of temporary repairs of old pavements that will undoubtedly either be reconstructed or resurfaced sometime in the near future.

The proper time to seal cracks in pavements is in the spring and fall, when the cracks are open as a result of the pavement being contracted and weather conditions are suitable for pouring the cracks. Both tar and asphalt are used for this purpose, the joint usually being covered with sand or fine aggregate.

A field which has been entered recently in a few places is that of the stabilization of shoulders along hard surface pavements. Shoulder maintenance is one of the expensive and continuous problems where traffic is heavy. In some localities where sod shoulders have been satisfactory, the problem has been more or less solved in that manner. However, where the traffic is of such a nature and amount that the shoulders are being used to a considerable extent, something should be done to solve the problem of building and maintaining satisfactory shoulders. The answer seems to be in shoulder stabilization, and with its vast possibilities this field undoubtedly will be opened up to a great extent during the next few years.

Bituminous Treated and Road-Mix Types

There is a considerable variance of opinion as to what should be done with traffic-bound bases. Some engineers favor starting out with light treatments and gradually building them up over a period of years. The argument in favor of this is that after the first year of service they will be able to determine whether or not this type will

carry through or if it will be necessary to follow up with a heavier top. On the other hand, some are of the opinion that very few traffic-bound bases are sufficient to carry light treatments and that a heavier top should be put on to begin with. There is no definite recommendation to be made in this respect on account of the fact that there are so many variable conditions involving such matters as the value of the base, sub-grade conditions, volume and nature of traffic and climatic conditions. Experience with the different types under the various conditions alone will tell what is the proper thing to do in a given case.

One of the puzzling questions which confronts the county engineer is what should be done with traffic-bound bases which have been worn to such an extent that there is some question about satisfactorily supporting a bituminous top. The answer, in most cases, seems to be that the base course should be rebuilt and strengthened, finishing off with a lighter bituminous top, rather than to attempt to build up all of the strength by constructing a heavy bituminous top. Some very satisfactory work has been done in rebuilding bases by compacting crushed gravel with a sufficient amount of fines to bind the aggregate properly. After proper compaction it may be primed and surfaced. In other cases, particularly where the traffic is heavy, a four-inch water-bound macadam course, finished off with a light bituminous top, has proven to be an excellent pavement.

Road mixes vary in thickness, but it is generally conceded that 2½ inches compacted is about the maximum which can be handled successfully and obtain the proper smoothness. In some cases thicker tops have been laid successfully by constructing them in two courses, using a coarse aggregate in the base course, and finishing off with a light top using smaller aggregate.

Untreated and Low-Cost Types

The general practice in the maintenance of untreated types is to maintain practically a bare surface during the summer months and to carry a layer of floating material in the spring and fall when conditions are such that some aggregate may be worked into the surface. Where dust layers are being used, it is especially advantageous to have the surface free from any material which might act as an abrasive tending to ravel the surface.

Dust layers have been used to a considerable extent in many of the counties and the results have been very satisfactory. The principal materials which have been used are calcium chloride and road oils. In dust laying, the material used should produce a surface which is well compacted but at the same time will, under certain weather conditions, permit the floating and light blading of the surface. The question is sometimes raised as to whether or not a county can afford to use dust laying materials. Careful observations and studies seem to prove that the cost of dust laying materials does not exceed the cost of material which is lost off the surface of the road during a season. It would seem logical to spend the required funds to save the materials from being dusted off and at the same time to provide comfort and convenience not only to the users of the road but to the people whose homes are along the highway.

Quite a number of counties are now entering into the field of stabilization of low-cost roads. This process has made it possible to make good use of many local materials that a few years ago were not considered to be satisfactory for road construction. Another advantage of this type of construction is that the maintenance costs are very low compared to the old traffic-bound types. This is due to the fact that the surface is bound

and does not require the continual blading and dragging and the addition of materials from time to time. The maintenance of this type of road is not particularly difficult if the correct methods are followed. This field seems to have enormous possibilities for counties, particularly where they do not have sufficient funds to build higher types, and on certain roads in all counties where they are in need of low-cost construction and maintenance.

Snow and Ice Removal

The majority of the counties where snow and ice is a serious problem keep certain men in their maintenance departments under standing orders to start plowing snow and to take care of icy conditions at such times as are necessary, rather than to await orders to be issued from a central or district headquarters. This seems to be the most efficient plan for prompt service.

One matter which should be given careful attention is that, wherever possible, the snow should be plowed completely off the shoulders and into the ditches. This should be done for two reasons; the first being that it makes room for snows that follow, and the second is that when the snow melts, the water is where it belongs rather than lying along the edges of the pavement and on the shoulder where it will do considerable damage.

Practically all counties use precautions against icy pavements; the majority of them use calcium chloride or salt mixed with sand, grit or cinders. Some counties have followed the practice of treating their roads, especially the main traveled ones, throughout their entire length. The majority, however, have not yet progressed to that point but take care of all dangerous places on the road.

Roadside Beautification

There is a distinct difference between what might be termed roadside beautification merely for the purpose of adding to the attractiveness of the road, and beautification which has along with it some practical value. While some counties are doing some of the former, the majority of this class of work, where it is being done at all, is in the nature of sodding of shoulders and slopes, together with the planting of various kinds of vines and shrubs, particularly on the high slopes in cut and fill, for the purpose of preventing erosion.

A little experience with this type of work will readily prove that the cost of doing planting to prevent erosion is soon offset by the saving in maintenance.

To start out, the average county will have to buy its own nursery stock, but it is surprising how cheaply the various types may be grown, and any considerable program of this kind of work would justify the county in growing its own stock.

Excavation Barriers Required for Protection of Travelers Only

The New York Court of Appeals held, Swift v. City of New York, 270 N. Y. 162, 200 N. E. 681, that a city ordinance requiring the erection of such a fence or railing about an excavation in a street "as shall prevent danger to persons traveling the street," was intended for the protection of persons traveling on the highway in the usual manner. The city's codefendant, the Bronx Water Works Corporation, was held not liable for injury to a child who slipped while running upon a pile of dirt alongside an excavation being made for a water main. Even if the ordinance had been applicable, there was no evidence that its violation was the proximate cause of plaintiff's injury.

Courtesy Asphalt Institute

Courtesy Bureau of Public Roads

At the left, a broom drag for leveling operations on light surface treatment work in Maryland. At right, a tail gate spreader is placing aggregate cover on seal coat work.

How to Maintain Highways and Streets

This article treats many of the important details of maintenance work and suggests methods and procedure for usual problems.

CONTINUOUS maintenance is required on all highways no matter how constructed or of what type. This may be divided into two parts — surface maintenance and incidental maintenance, which includes shoulders, ditches, slopes, and other general right of way items, culverts, bridges, guard rail, signs, etc. Modern traffic demands not only a good surface but safe operating controls as well. These may include overhead lighting, automatic intersection lights, etc. The first essential for good maintenance is good organization with competent trained personnel; the second is good equipment and material, for which specialized equipment and materials have been developed in order that a minimum delay will occur in carrying on necessary work.

Surface Maintenance

Strictly speaking, maintenance means maintaining the surface as good as it was when constructed. Low cost surfaces such as surface treatments and road-mix types should constantly improve under maintenance as repairs for the first year or two are essentially construction items, and these, with subsequent surface treatments, increase the surface thickness substantially. The high type surfaces are maintained with intent to replacement of wear and tear only.

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Bituminous Types

The most common item is patching, necessitated by potholing or ravelling within the pavement or breaking of the edges. It is conservative to say that fully 50% of all patching done would have been unnecessary if more attention were given to the original construction or if when the patch was first made it had been done correctly.

Pot holes occur because of differential support on small adjacent areas; in surface treatments where there is a movement of the base; or where insufficient priming or bonding was accomplished. Ravelled areas, which later become completely broken through the entry of water, are almost invariably due to a porous surface resulting from omission of seal coat. This is a common error due to the mistaken idea that a non-skid surface is possible only when very coarse and open. The appearance of long lines, looking like scratches, on new cold-mix surfaces is certain evidence of incipient ravelling and a seal coat should be given at once.

Before making a patch an examination should be made to determine the cause. If due to faulty base or insufficient drainage these deficiencies should be remedied. Often in new construction it will be necessary to install additional drainage to take care of water pockets overlooked in original construction. Drainage corrected, one patch will be sufficient; overlooked, the trouble will recur every year.

The patch should be of the same general composition as the adjacent surface, especially in regard to size and hardness of aggregate.

A hard aggregate patch in a soft aggregate surface will soon have a ring pothole around it. The patch should be no deeper than the surface itself. For example a four-inch deep pothole in a two-inch deep road-mix surface should have the base repaired with base material, with a two inch bituminous patch in the top. So long as the same final viscosity of bitumen develops in the patch as in adjacent pavement, the grade of bituminous material may vary as is convenient.

The patch should be well bonded to the adjacent pavement and absolutely waterproof. Too many patches are made of porous mixtures, and act like so many drop inlets which introduce water under the pavement which then falls again.

Many times pavements are continually patched when what is really needed is a new surface treatment or a definitely thicker surface, because the old surface has passed the critical point in load support. When patching reaches anywhere near 5% of total surface area, this is a certainty.

Having remedied the basic trouble causing surface failure, the question arises how to patch? To purchase pre-

Courtesy Tarrant Mfg. Co.

Typical of good maintenance work is this job of building up the contour of a side road intersection.

mixed material from some commercial producer, to produce the same mixtures at some central point or to make a patch in place either under gang or patrol maintenance.

Usually the great majority of patches occur in the spring, and in the first general repairs, patching is largely done by gang maintenance. For surface treatments, road-mix and cold-laid plant mix surfaces, pre-mixed material can be prepared in small concrete mixers and stockpiled. Coarse graded aggregate mixtures and rapid curing bituminous materials are made up only a day or two ahead as this is sufficient curing period; but dense graded aggregates and medium curing bituminous products may be stored for several weeks, and thus may be prepared in advance of patching work. For macadam aggregate mixtures, it is desirable to make up patching material so that the smaller size can be sprinkled over the main body of the patch and key it.

All patches should be tamped or rolled thoroughly in place. If the coarse material is tamped to grade, and then covered with fine mix and tamped lightly, the patch will conform to the adjacent surface after subsequent traffic and will be waterproof. Except for skin patching it is not possible to make a real good patch with but one size of patching mixture in macadam type. The coarse mix is necessary for stability in the bottom of a deep patch, and the fine mix for sealing the surface and feather edging to conform to adjacent areas. Patching should simulate construction.

Patching mixtures are made in two principal ways:—at a central point, usually the maintenance headquarters; on along the roadside. Equipment will vary according to the kind of surface under repair and the mileage under maintenance. Central mixing plants may be of the regular pug mill type with 1000 or 2000-pound mixing boxes, and patching mixtures are produced incidental to other construction. Where such plants are not available the most common unit is a concrete mixer, in whatever size available. The 27 E paver is used where large quantities are required. For the specific purpose of making patching mixtures and well adapted to the smaller maintenance units is the 7 ft. mixer, which will turn out seven tons an hour without difficulty, and can be readily adjusted to the different sizes of aggregate as conditions require. Concrete mixers may be heated by oil burners or torches, so that wet aggregates may be dried, and better mixing accomplished in cold weather. Aggregates may be dried, to some extent, by adding a few quarts of kerosene to the aggregate before the bituminous material and setting it on fire. The best method in the absense of a regular dryer, for small amounts is to stockpile the aggregate over corrugated iron pipe in which fires are kept burning. Very good drying can be done by this method, especially where oil burners or torches are available for heating.

Heating of bituminous materials may be accomplished in storage tank, in a distributor, or in heating kettles. Kettles are used to the larger extent as the initial cost is small and a number may be obtained and located at strategic points. These are heated by oil burners. It is desirable to have them mounted on rubber tires to facilitate movement.

Heating of bituminous materials for patching mixtures is desirable as it permits the use of heavier viscosity products, better coating of the aggregates and quicker set-up in the patch after placement. In combination with mixing units it also provides for the manufacture of denser graded aggregate such as a combination of macadam aggregate and sand similar to bituminous concrete, so that any desired texture to match existing surfaces may be obtained. In a number of instances these mixtures are being used in place of surface treatments, the usual rate of application being from 25 to 35 pounds per square yard.

It is better to have patching mixtures on the lean side as they can be tightened up by adding a little sand on the surface if necessary.

For macadam aggregate surfaces such as surface treatment and road-mix the amount of bituminous material should be from 3.5 to 4.5% for coarse mixes and 4 to 5% for finer seal mixes. This is at the rate of 10 to 14 gallons per ton of aggregate depending upon specific gravity and absorbent qualities. For dense graded aggregates the quantities will run higher, especially if much 200-mesh material is present—as much as 25 to 30 gallons per cubic yard.

Coarse graded bituminous macadam should be patched with the same texture of surface. If of the open type where very hard tough stone is available, the broken area should be removed and new clean stone carefully placed and rolled to conform to the adjacent surface. The hot bituminous binder should be poured by hand, covered with the finer sized aggregate and again rolled. Where a dense seal is employed, or where the aggregate is softer, a premix patch will be found advisable.

Dense graded hot-mix pavements such as bituminous concrete should be patched with the same type material whenever possible. If such mixtures are not available incidental to other construction, it is often advisable to employ a small portable hot-mix plant for the purpose.

The most common maintenance on hot-mix surfaces is crack pouring. Cracking is of two kinds, one due to contraction and expansion, the other to drying out of the surface itself. The former may be reflected cracking from a rigid base and once occurred is not likely to increase. The second tends to increase with age. So long as the crack is less than ⅛ inch in width it is better to leave it alone, rather than to attempt to pour it with a crack filler. The crack will not be filled, the result is unsightly, and with cold weather the crack will reappear.

With cracks wider than ⅛ inch, the following method is recommended. Clean the crack thoroughly, preferably by a jet of compressel air, and remove all loosened fragments from the edges. The compressed air tank on the roller or a separate small air-compressor may be used. Next fill the crack with a lean bituminous sand mix, brushing the mix well in until the crack is full. Low viscosity products should be employed and 3 percent by weight is enough. Such a mixture will have the consistency of moist sand and may be broomed readily into quite small openings. The surface of the crack may be poured with a rapid curing product to seal the top of the sand-mix and bind it to the edge of the crack. The bituminous material preferably should be similar to that in the existing pavement. By this method the crack will be permanently sealed and after a short period under traffic will become quite unnoticeable.

Check cracking is at first isolated in amount. While the pavement may go for years before any attention is required, it is an indication of too dry a pavement, due to either age, or too hard a bitumen cement in construction. Repairs are best accomplished by a light surface treat-

When you need special information—consult the *classified* READERS' SERVICE DEPT., pages 59-61

Left, patching dense graded asphalt road-mix; right, concrete mixer for cold patch material.

ment, not exceeding .2 gallon per square yard and covered with fine aggregate; often .1 gallon and 10 pounds of sand will accomplish the purpose.

When only a small area requires surface treatment, not large enough to call for regular distributor equipment, the surface may be treated by applying bituminous material by hand using a heavy gauge sprinkling pot having a rosebud nozzle, drawing the heated material from a portable kettle. There is also growing use of the small sprayer, in which material may be heated, and applied by hand spray nozzle. They have a wide field of use, both in surface treatment of small areas and in patch construction of all kinds. These are invaluable for the town and county that does not own a distributer.

A method of maintenance particularly well adapted to city streets is the surface heater method. Repair costs may be reduced markedly as it is necessary to remove but a part of the old surface. A surface heater consists of a shallow inverted steel pan containing burners which are so arranged to apply heat direct to the pavement. They are made in several sizes ranging from 2′ x 4′ with two burners up to 7′ x 8 ′with six burners. Originally used in patching operations only, the larger sizes may be used in resurfacing an entire street. The 7′ x 8′ size will cover as much as 2200 square yards per day, the heating time for the 56 square feet being but 45 seconds. Fuel consumption by the six burners is about 25 gallon No. 4 oil per hour. The great economy comes from the fact that by merely removing the upper inch of worn, uneven, dried out surfaces and replacing with fresh mix, the entire old foundation is salvaged with a minimum of new materials.

Sometimes dense graded hot-mix pavements are constructed with excess bituminous material so that the surface is either too smooth or tends to shove. This condition may be remedied by the use of disc scarifiers which both smooth the surface and leave slight grooves which increase the traction of motor traffic.

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Brick and Block Pavements

Brick and block pavements may require maintenance (1) by reason of failure of occasional brick or block, (2) the cracking of the surface where cement grout is used, (3) the loss of filler where bituminous materials are used, and (4) settlement due to inadequate foundations.

When areas require replacement either because of poor material or settlement, the bricks or block should be removed well beyond the failed section, the base repaired if necessary, the cushion replaced and new block laid to proper cross section, rolled in place and the joints filled. So far as possible the same color and type of brick or block should be used for repair and the same kind of joint filler as in the original construction, both for appearance and behavior. Cracks may be filled with original type of joint filler or by the sand-bituminous mix.

Where old brick pavements, particularly those on plain sand cushion and without filler, have settled or rutted, they may be salvaged by removing the brick from the surface entirely, reconstructing the base, placing a new cushion course, and then turning the brick to a new face. The joints should be filled with bituminous filler. Stone block pavement may be salvaged in a similar manner, and also by splitting the block and resetting the halves so that the freshly broken face is on the surface.

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Portland Cement Concrete

Portland Cement concrete surfaces require maintenance because of (1) cracking, (2) scaling, (3) settlement at joints, (4) settlement over larger areas due to faulty subgrade. A certain amount of cracking occurs either due to contraction not entirely provided for by the longitudinal and transverse construction joints or to insufficient subgrade support. If due to faulty subgrade the cause should be remedied. Frequently better drainage will take care of the situation, and water seeping through the cracks or joints after a rain is evidence that such procedure is needed. Cracks are often poured before needed and frequently too heavy a bituminous product is used. As in hot-mix pavements, it is usually not desirable to pour cracks until they are over ⅛ inch in width. Cracks are widest in cold weather, and consistent with the need for waterproofing and convenience in doing work this filling is best done in late fall or early spring, the fall being preferable as the surface is dryer. Asphalt cement (50-60 pen.) mineral filled asphalt cement, cutback asphalts, emulsified asphalts and tar are all used for crack-filling. The heavier products are poured hot. Heating kettles of 50 or 100 gallons capacity are used or sometimes a distributor is employed. Hand pouring pots of special cone shaped design are best suited for the purpose. The small distributor or spray machine may be adapted for crack pouring by the attachment of a hose and special nozzle.

Scaling is due to non-removal of laitance, as a rule, during construction. Until the surface shows signs of disintegration, it is best left alone. When becoming deeper, further deterioration can be stopped by waterproofing the surface. This may be done by the application of approximately .25 gallon low viscosity bituminous material covered with fine size crushed aggregate or coarse sand. The bituminous material should have high penetrating qualities so as to adhere firmly to the concrete.

Settlement at joints is due to impact of heavy trucks and is always on the slab

beyond in the direction of traffic. If not repaired the sunken slab will eventually crack about ten feet from the joint. Two methods of repair may be used, one a bituminous patch of dense graded aggregate, the other raising to original level by "mudjacking". Where the bituminous patch is used the surface should be first primed with the proper grade of cutback asphalt, emulsified asphalt or tar so that the patch can be feather edged.

For settled areas the "mudjacking" method of repair is increasingly used. The process consists of pumping a mixture of mud and cement through holes drilled in the pavement until the slab has been raised to its original position. The mud-cement mixtures harden and give durable support in the new position.

Settled areas, as well as broken areas, are also repaired by either bituminous patches or portland cement concrete patches. For bituminous patches the two-course macadam aggregate mixtures may be used for depths above ¾ inch, and the sand mixtures for lesser depths or for sealing coarser mixes. Portland cement concrete patches should be of a mixture as near like the original mix as possible so that they will react under temperature changes in a similar manner. The old surface should be thoroughly cleaned and just before the patch is placed should be moistened and a thin layer of neat cement brushed on to make a good bond. The patch should be protected from traffic until thoroughly cured.

Shoulder and Ditch Maintenance

Shoulders are required to preserve the pavement from edge wear and for safety to traffic; minimum width should be 5 ft. —more where possible. Shoulders are usually of earth, maintained by blading or dragging, but severe traffic conditions require higher type. Some maintainers have attachments for backsloping so that shoulder, ditch and slope are all cut at the same time.

Shoulders after maintenance for a year or two or if of clay soil and well compacted at the time of construction are often seeded to grass as a means of preventing erosion and to give more support in wet weather.

Earth shoulders are often reinforced by stabilization with admixtures of stone, gravel, slag and other materials, and bonded with bituminous materials. One method is to remove approximately 3 inches of the old earth shoulder by a special scarifier and grader and then to place new aggregate. This aggregate is then penetrated with bituminous material as in road-mix construction. Application is made with a pressure distributor, a canvass shield being placed on the spray bar so that the pavement proper is not splashed, and with all the nozzles being cut-off except those directly over the shoulder. Special narrow width harrows or blade maintainers are then used to accomplish mixing. The bituminous shoulder is compacted by light rolling, and then further maintained by light blading, and the addition of pre-mix material to bring up the low places. Dense graded aggregate mixtures are best suited for shoulder construction as the addition of new material to maintain level is easier, and are waterproof and bond better to the edge of the pavement.

Stabilizing shoulders is also an aid in maintaining open ditches and drainage structures as erosion is practically eliminated. In many areas the reduction in cost of these items alone will almost pay for bituminous shoulders.

Cross drainage should be frequent enough to prevent ditch scour, but often after construction it develops that additional ditch paving may be desirable. Such paving may be done with the regular maintenance equipment, using bituminous cold patch and crack filler. After shaping the ditch to proper cross-section, the cold-patch is tamped in place to a compacted depth of 4 inches. The crack filler should be applied hot and allowed to penetrate so as to make a flush seal. Such a ditch lining will be flexible enough to undergo slight settlement without cracking, and yet firm enough to remain in place under hot summer sun even on a 45° slope. For cold patch the small concrete mixer will be suitable, and for heating crack filler the 100 or 150 gallon kettle.

A Digest of the Sewerage Literature of the Month giving the main features of all the important articles published.

The Digestion Tank

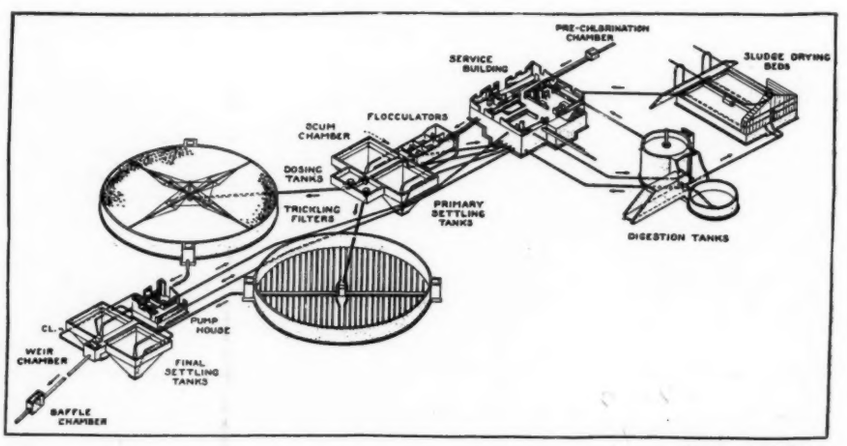
Mechanical equipment forms the special feature of the treatment plant of Battle Creek, Mich., population 44,000; designed capacity, 9 mgd dry weather, 12 mgd wet weather. (Present flows are 6.6 and 13.2 mgd, respectively.) Sewage crosses under the river at 5 points through inverted siphons. Sewage is pumped by 2 motor-driven and one gas-driven pumps. The gas engine has gas pressure regulator, flame arresters in gas and air connections, electric starting and generating system, temperature indicator and thermostatically controlled ignition switch, mechanical speed control of pump between 8 and 3 mgd. Two screw-feed sludge pumps driven by 2 hp motors. Two vacuum pumps. Oil-fired boiler; gas-fired boiler with pressure regulator, draft hood, gas shut-off valve, pressure and vacuum gauge, thermostatic pilot control; gas-fired water heater; 3 gas meters. Chlorine taken from 1-ton containers on 4,500 lb. scales; 3 W. & T. chlorinators; containers handled by narrow-gauge track, and 4,000 lb. revolving jib hoist; exhaust fan at floor of chlorine room controlled by switch outside. Crude sewage meter and sludge meter, with registers. Two 12.5 mgd comminutors, motor driven, automatically stopped and started by head through baskets. Industrial railway, ½ mile of 24″ gauge track, gasoline locomotive, and 6 one cu. yd. cars, service 12 filter beds and 8 lagoon beds. A 26′ square detritor, motor driven. Two primary 80′ "Si-feed" tanks, with skimming baffle. Two "mult-digestion" tanks with floating gas-holder covers, the primary tank with 2 turbo-mixer agitators. Twelve under-drained sludge beds 25 x 100 ft., and 8 lagoons 50 x 100 ft. Water supply, 2 wells 105 ft. deep with 50 gpm motor driven turbine pumps.[G3]

Treatment trends in separation of suspended solids from liquid sewage are toward use of physical methods; in oxidation of organic matter toward biological methods; and in dewatering and disposition of sludge toward a combination of both, with the physical predominating. For the first, the choice is between plain sedimentation and chemical precipitation, with rapid filtration as a possibility to be watched with keen interest. For oxidation we must still depend upon bacteria; recent developments include use of anthracite as a culture substratum, and greatly increased rates of trickling filter dosing. For sludge treatment, separate digestion and vacuum filter dewatering, with final disposal by incineration or use as fertilizer, occupy the field. As to mixing ground garbage with sewage, the expense of house grinding would seem to be prohibitive; municipal grinding and discharge into the sewage greatly increases the burden of separating solids from liquid sewage; mixing ground garbage with partially dewatered sludge or screenings seems to offer real possibilities. (Prof. Winslow.)

So much attention is being paid to treatment methods and details that we may neglect proper consideration of the sole object of sewage treatment—the production of an effluent suitable for discharge into the body of water receiving it. "The only result which counts is whether the plant effects an improvement in the stream commensurate with the cost of operation." Untreated industrial wastes may be more detrimental to a stream than the entire flow of untreated sewage. It would be better to consider stream conditions, waste treatment and overall efficiency of sewage treatment, rather than "mechanical devices which make plant operation easier or, possibly, more complex." (Mohlman.)[H23]

Holland has developed sewage treatment from that of trade and industrial wastes. Methods of digesting organic wastes, accompanied by gas collection and utilization, were in operation more than 20 years ago, along the lines developed for sewage sludge in this country. Floating gas holders and a 140 hp motor driven by gas were in operation in 1909, some of the gas being sold to the city. Tendency in sewage treatment has been toward producing highly stabilized effluents, the development of simple but greatly mechanized equipment, and means for easy operation. Some small plants run with only casual supervision.[H25]

Aluminum is used to a considerable extent in a treatment plant for the U. S. Dept. of Agriculture Experiment Station at Beltsville, Md. The two grit chambers are controlled by aluminum slide gates at entrance and outlet. In the two primary settling tanks and two final settling tanks, all weirs, baffles and slide gates are aluminum alloy. Leaving the final tanks, the effluent passes through an aluminum 90° V-notch weir with an electrical transmitting apparatus and a recording and totalizing apparatus. The flow diagram prepared by the engineer, reproduced herewith, is somewhat unusual.[H4]



Municipal Sanitation

Diagram of sewage treatment works, National Agricultural Experiment Station, Beltsville.

Measuring sludge with venturi meter was tested at Baltimore sewage works, using an 8 x 4-inch meter. When tried in Chicago, the piezometer rings clogged, but this was prevented in Baltimore by continuously running a stream of clear water through each ring. Four ½″ holes connected the meter with each piezometer ring; a 1″ pipe connected each ring with a closed sedimentation chamber, and this with a mercury manometer, and clear water flowed through a 1/16″ orifice (therefore the same amount in each) into each of these pipes, through the rings and ½″ holes into the meter. Manometer records differed from volumetric measurements by —5.0% to +7.3%, some of this inaccuracy being attributed to the specific gravity and viscosity being greater than water. It was thought that larger openings into the piezometer rings would give better results.[E2]

Bulking activated sludge, which then consisted almost entirely of filamentous organisms, became excessive in the Flora, Ill., plant in hot weather, disappeared in cold. As remedies, there were tried a 50% reduction in aeration tank detention period, diluting the raw sewage with 125% of effluent, maintaining a pH of over 8.0 by use of lime, reaerating the return sludge, and chlorinating the return sludge, but none of them prevented the bulking. On May 8, 1936, the entire sewer system was flushed out with fire hose, washing into the plant black sewage with a strong odor; this upset the plant but immediately the filamentous organisms and bulking disappeared. Sewer laterals were flushed weekly thereafter and no bulking occurred and a consistently excellent effluent was produced. Apparently the bulking was due to the toxic effect of active, partially digested sewer sludge on the aerobic organisms in the aeration liquor.[C6]

Two-stage digestion at Durham, N. C., produces 40,000+ cu. ft. of gas per day (1.32 to 1.63 cu. ft. per capita), which operates gas engine-generators, current from which operates various plant units, the excess going to the city's power system. The engine cooling water heats the digestion tanks (2 primary and one secondary). Calorimeter records of the gas has proven a very accurate and continuous check of digester efficiency. "When a substantial drop in Btu value is registered it is time to look for trouble in the digesters." (Average Btu=734). The pH values of sludge and supernatant are less reliable. 90% of the available gas is evolved within 36 hours after the addition of the raw sludge, unless this exceeds 2% of the tank contents on a solids basis, when a longer time is required. Four sludge drying beds are covered, 6 are not. "The glass-covered units have proven a life saver in long spells of bad weather."[H1]

A **central research** department for the sewage plants of the nation was advocated by Joshua Bolton, president of the Institute of Sewage Purification (England). Individual cities did not have the funds for thorough investigation nor a properly trained staff. English electrical plants contributed $1 for every $2,500 of revenue to maintain a central research department, and gas plants 23 cts. for each million cu. ft. of gas made. Cities might contribute to a central research bureau. Much of the recent progress was due to the investigations of commercial firms, but they were necessarily biased in their investigations, and must add their cost to that of their products sold.[D3]

Multiple-hearth incinerators are included in four plants now under construction at Kokomo, Ind., Laporte, Ind., Colorado Springs, Col., and Kaukauna, Wis., designed to burn garbage and sludge. At Kokomo it is planned to burn 8.5 tons of digested sludge cake and 9.9 tons of wet shredded garbage in 24 hrs.; the latter delivered by conveyor into the sludge mixer or directly into the furnace. At Laporte the capacity is 3.64 tons of digested sludge cake and 10 tons of wet shredded garbage. At Colorado Springs the furnace is designed for 16 wet tons of digested sludge and 6 wet tons of shredded garbage. The Kaukauna furnace is designed for 8.33 tons of undigested sludge cake and wet shredded garbage in 6 hrs. during ten months of the year; and during the other two months, 33.33 tons of chemically precipitated sludge cake and wet shredded garbage in 2 hrs. In each of the first three the sludge cake is estimated at 50% combustible, moisture 70 to 75%, 5,000 Btu's per pound of dry solids; and the garbage at 85%, 85% and 70% combustible, respectively, and 75%, 80% and 75% moisture.[H5]

Incineration of screenings, sludge and in some instances of skimmings, scum and grit, has been employed in plants to prevent nuisance of sludge beds, where area for such beds is restricted or where the surroundings make them undesirable. Screenings can be burned readily in refuse incinerators; sludge can not unless as fairly dry cake, and then only if "well distributed in a heavy preponderance of other combustible material. Burned alone in such a furnace, the sludge balls and hardens in such degree as to resist the penetration of heat." Choice of incineration of sludge involves the question of whether it is to be burned as fresh solids, or as partially or completely digested, these varying in volume, heat values and possibly nuisance effects. Development of special types of sludge incinerators is very recent and far from standardized. One at the Chicago Calumet plant started operation in 1936 after several years of experiment; capacity 40 tons of dry solids in 24 hrs.; builder, Combustion Engineering Co.; operation—filter cake and previously dried sludge, mixed and shredded, are discharged at the top of a vertical "hot tower," where gases of 1000° F. carry it down to a cage mill; then (dried to 10% moisture and comminuted) to a centrifugal separater, whence it is taken as fuel to the hot tower or used as fertilizer. The Nichols-Herreshoff incinerator has been in service at Dearborn, Mich., for two years, and 11 other installations are under contract ranging from a 3-ton plant for Middletown, Conn., to a 400-ton (4-furnace) installation at the Cleveland southerly works. This is of the multiple-hearth type, with 4 to 8 circular refractory hearths superimposed, the sludge passing in succession from top to bottom hearth and emerging as fine ash. (This has been described in detail in PUBLIC WORKS.) The Dearborn 50-ton plant cost $56,000 including foundations; the Cleveland 400-ton plant $397,300 not including foundation. There remains from incineration the ash which amounts to 35% to 50% of the sewage solids. Incinerator builders guarantee capacity, absence of nuisance and operating cost.[H18]

German treatment practice has been changing to effect conservation of natural resources—greater crop production by irrigation and fertilizer production, recovery of grease, oil and soap, and fish culture; by methods not always economically sound. Application to soil by spraying and rain-simulating devices is being markedly developed; also utilization of sewage gas for vehicle operation, refined methods of grease recovery and utilization of by-products from trade wastes.[H25]

Canning wastes were digested in 5 gal. carboys by the Wisconsin Bureau of Sanitary Engineering, pea and corn wastes being mixed separately with domestic sewage sludge, raw sewage solids and activated sludge, and digested for 100 days. From the experiments it was concluded that: (1) Solids from pea canning wastes to the amount of 20% by weight, or from corn canning wastes to the amount of 5%, probably will not interfere materially with normal operation of a sewage sludge digester. (2) Pea solids to the amount of 40% or more, or corn solids to the amount of 10% or more, will interfere materially with normal digestion of sewage solids and probably result in a decreased rate of digestion, abnormally low pH values in the digester, and low calorific value of gas produced due to high CO_2 concentration.[G4]

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c, Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

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January 1

12. *p.* Elements of Sludge Digestion. By J. McNicholas, pp. 5-7.

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13. *p.* Disintegration of Solid Matter in Sewage. By H. R. Lupton, pp. 69-72.

E *Engineering News-Record*

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4. *p.* Centralized Sewage Disposal for Greater London Area., pp. 891-892.

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5. Cost of Cities' Sanitation Service, pp. 56-57.
6. St. Louis Grinds Its Garbage, pp. 58-61.

H *Municipal Sanitation*

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14. Developments and Trends in Industrial Wastes Disposal. By F. M. Dawson and H. W. Ruf, pp. 25-28.
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16. Sewage Plant Mechanization—An Accelerating Trend. By H. W. Taylor, pp. 29-32.
17. Trends in Chemical Treatment of Sewage. By C. C. Agar, pp. 33-36.
18. Present Status of Incineration of Screenings and Sludge. By G. S. Gascoigne, pp. 37-39.
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28. Sewage and Industrial Wastes Disposal in Florida. By T. S. Kennedy, p. 104.
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M *Canadian Engineer*

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6. *c.* Rehabilitating a Large Sewer of Inadequate Strength. By J. P. Reinheimer and H. E. Senf, p. 15.
7. *p.* Economic Considerations in Treatment of Industrial Wastes. By M. J. Blew, pp. 54-55.
8. Liquid Wastes Contributed by Industries, p. 55.
9. Treating Industrial Wastes in Wisconsin, pp. 56-57.

Following is a digest of the important articles published last month having to do with water works design, construction and operation and water purification, arranged in easy reference form.

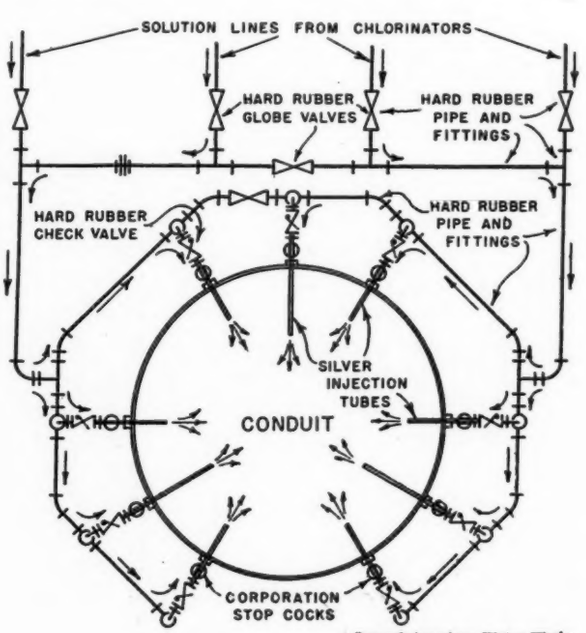
The Water Wheel

Ammonia handling should be through heavy steel pipe; joints flanged with corrugated lead or rubber composition gaskets, or threaded using litharge and glycerine, preferably the former. Armored rubber hose may be used for short connections. Valves should be those made especially for ammonia. Pipes should drain back to container or to drip legs of ample capacity. Ammonia is lighter than air—ventilate at the ceiling. Leaks can be located by white vapor produced when either hydrochloric acid or burning sulphur tape is held near them. High concentration of the gas irritates the eyes and may cause permanent damage. Liquid ammonia may severely injure the skin. Suitable gas masks should be kept on hand. Gas can be absorbed by spraying water into the air containing it.[A14]

Chlorine residual is kept constant at Los Angeles plants by use of a residual chlorinator, which saves $50 worth of chlorine a month at one plant and $125 at another, and also prevents under-chlorination. Chlorine demand may vary 100% during a season and has varied 79% in one day; due to temperature changes, algae growths, turbidity caused by heavy rains or wind over the reservoir. A rainfall of 3½" in a day has increased the demand from 2.1 to 4.5 lb. per mg. Wind of 25 miles per hour increased it from 2.3 to 3.1 lb. "By maintaining a constant residual, adequate disinfection is assured at all times, the possibility of complaints from periods of overdosing required under any scheme of manual control is eliminated, and in large plants a material saving in chlorine gas used for disinfection is obtained." The machine makes a residual chlorine test every 3 minutes and adjusts dose accordingly. For accurate control, thorough mixing of chlorine with the water is essential for satisfactory control so that the samples tested shall be truly representative; when applied at only one point in a conduit, the residual at one point 1,000 ft. lower down has been 2½ times as great as at another in the same cross-section. A header manifold applying the chlorine at 9 points is used, giving perfect uniformity 1,000 ft. away.[A10]

Chlorinating Chicago's water supply at the new Cermak station (300 mgd. capacity) uses ton containers of chlorine to provide greater safety of operation and reduce cost. Ten months' operation has been so successful that similar layouts will be installed in other plants. There are separate rooms for receiving and storing containers; for containers in use; for chlorinators and scale dials; and for the attendant's office; with fixed windows between them, and a large plate glass window between chlorinating room and main corridor for visitors. Each container in use rests on a 2-ton scale equipped with recording apparatus which automatically prints the scale weight on a tape at 15 min. intervals. There are four 750 lb. W. & T. master-vacuum, manual control solution feed chlorinators (of a newly developed type) each with 2 injectors (a third can be added); capacity can be increased to 2,000 lb. per day. Chlorine solutions are carried through 1½" special rubber hose, resting in metal trays and carried through 4" pipe conduit across the street to the chlorinating shaft. The water which operates the chlorinator is maintained at 55° F. or higher by a thermostatically controlled steam heater; also is filtered to prevent clogging of chlorinator orifices. Each room is provided with forced air evacuation permitting better than one air change per minute, fresh air being forced in near the ceiling and drawn out from the scale pits or other lowest points. These fans are operated by push button controls in the attendant's office. In the receiving room is a tank of caustic soda sufficient to absorb more than a ton of chlorine.[G4]

A **self-operating purification** plant at Durham, N. H., treats 300,000 to 650,000 gpd with all operations automatic except filter washing. When water in the elevated tank drops 8 ft. below the overflow, a pressure-actuated control starts a high-lift pump, drawing from a filtered-water basin. When the basin level falls to 18 in. below the overflow, a float switch opens the hydraulic valve in the filter effluent main and starts the hypochlorinator and the alkali feeder. The filters then start (at a rate controlled by rate-controllers), lowering the coagulation basin level, and when this has dropped 6 in. a float switch opens the hydraulic valve in the raw water supply main, and starts the alum feed, and an alkali feeder if necessary. When the elevated tank approaches the overflow mark, the process is reversed —the control stops the pump; the filtered-water float



Journal American Water Works

Chlorine solution injection header.

PROTECTION . . .

THE AVERAGE PERSON does not fully appreciate the efforts made by the personnel of the water plants in protecting the health of the community through the furnishing of a safe water.

In making water safe, oft times it is done at the expense of palatability.

Most every one will judge the safety of the water by its palatability, and frequently the overdosing of chlorine to make it safe, leaves such an unpalatable taste that often the consumer dangerously resorts to the use of so-called sparkling water from the "old dug well, spring," etc.

Every day there is a fuller realization of the part that AQUA NUCHAR (ACTIVATED CARBON) plays as a protective measure not only against complaints arising from tastes and odors, but indirectly against epidemics following the use of water from unauthorized sources.

A recent survey shows that the furnishing of palatable water through the use of AQUA NUCHAR averages less than 5c per person per year and it must be readily admitted that a cost such as this will fully justify its continuous use.

"MAKE YOUR PLANS NOW TO ATTEND THE 57TH ANNUAL CONVENTION OF THE AMERICAN WATER WORKS ASSOCIATION TO BE HELD JUNE 7-11, 1937, AT THE HOTEL STATLER, BUFFALO, NEW YORK."

INDUSTRIAL
CHEMICAL SALES

Division
WEST VIRGINIA PULP & PAPER CO.
230 Park Ave., New York
205 West Wacker Drive, Chicago, Ill.
418 Schofield Bldg., Cleveland, Ohio

switch closes the filter effluent valve when the water rises to within 6 in. of the overflow and stops the chemical feeders; the coagulation basin float switch shuts off the raw water when it rises to within 6 in. of the overflow and stops the alum feeder. A pressure control in the wash-water supply tank operates a pump to keep it filled. A low water safety device stops both high-lift and wash-water pumps when water in the filtered-water basin drops to 12 in. depth. All pumps are automatically primed. Filters are washed once a day by hand.[G3]

Dry feed machines should be obtained to meet the conditions of the plant in question, and manufacturer should be informed of kind of chemicals to be handled; whether lump, granular or powdered; number of units and kinds of chemicals to be handled by each; minimum and maximum rates of feed desired; voltage and frequency of power used for motors; also a plan of the layout should be given which will inform him of the exact location of each feeder, whether it is connected by hopper to the floor above, whether mixing pot is desired, and general information concerning the purification plant. The manufacturer should furnish details concerning his equipment-capacity, chemicals suitable for, motor size, agitation of material in hopper, protection against dust, calibration, accuracy and uniformity of operation.[A114]

Chlorinated copperas used as a coagulant with lime at Dallas, although the mixing arrangements could be greatly improved, has demonstrated the following advantages:

1. Floc formation clean cut and of proper size.
2. Floc particles tough and resistant to breaking up.
3. Rate of settling is influenced by density of suspended material. Large amount of coarse suspension in raw water or a high bicarbonate alkalinity for reaction with lime aids in settling.
4. Floc ordinarily settles well and residual small floc going to filters is distinct and of sufficient volume to load sand beds well without building loss of head unduly.
5. Coagulating effect constant regardless of considerable variation in pH (8 to 9).
6. In handling turbidities around 3,000 ppm, 0.5 gpg chlorinated copperas will do the work if pH is elevated above 9.0 with alkalinity showing 5 to 10 ppm caustic.
7. A saving in coagulant costs results. Over a three-month period an average saving has been 67.6 cents per million gallons ($10.50 per day), which amounts to a yearly saving of approximately $4,000 at the Dallas plant.[A27]

Pumps of unusual capacity and efficiency have been developed for raising Colorado river water 1,616 ft. at the rate of 1,600 sec. ft. for Southern California, aided by special investigations at the California Institute of Technology. Efficiency was important because an efficiency drop of 1% would increase operating costs about $50,000 a year. Water is lifted at five plants of 9 pumps each (1 for reserve) of 200 sec.-ft.-capacity; lifts from 147 ft. to 440 ft. per plant. Tests showed no superiority of either single-suction or double-suction over the other; single-suction was adopted because of simpler station design. Single-stage pumps were adopted—never before used for such high lifts (maximum lift 476 ft); speed of 450 rpm and specific speed 1,430 will be attained. The specifications called for a minimum efficiency of 88%, with a bonus of $55,000 for each per cent in excess of the guaranteed efficiency. Models furnished by the three manufacturers awarded contracts showed 91.5%, and still higher efficiency is expected from the full size pumps. At present, 3 pumps are being installed at each plant.[E6]

When you need special information—consult the *classified* READERS' SERVICE DEPT., pages 59-61

Freezing hydrants, mains and services in Sheridan, Wyo., in February, 1936, kept the thawing crews busy 24 hrs. a day (3 shifts), and continued into April. Fifteen mains and two valves were broken; 41 hydrants out of 187 were frozen at the stub; 475 meters were removed, 200 with broken bottoms; 537 frozen services were reported (total number of services 2,835), most of which were thawed by electricity at a cost of $7.50 each; 150 services were broken in the goose neck or in the service line between the main and the stop box. Fire hydrants were thawed with steamers. An air compressor and a gasoline jack hammer were used to dig through the pavement and 5′ to 5½′ of frost.[F13]

CO_2 gas in Owens Valley water, which caused corrosion in the steel siphons, entered from the ground into a tunnel 7,000 ft. long in such volume that, when the tunnel was unwatered, it made a distinctly audible hissing, and it increased the CO_2 content of the water from a negligible quantity to 4.2 ppm. The gas is being drained out of the ground around the tunnel by a 15″x15″ trench cut out of the rock under the invert of the concrete tunnel lining throughout the length of the tunnel, and connected to canyons by eight adits sloping downward from the longitudinal trench through which the heavy gas is expected to flow into the canyons.[E2]

Portland cement joints are used for cast iron pipe in Los Angeles. Joint first juted. Cement, merely dampened, is tamped in in several layers, beginning each at the bottom of the bell and calking each tight with a 3 lb. hammer. Joint will stand pressure in 24 hrs. An 1,100 ft. length of 20″ pipe so jointed was tested under 80 lb. pressure; leaked 3 gal. per minute at first, dropping to 1½ gal. in 24 hrs., ¼ gal. in 48 hrs., and 2½ yrs. later was absolutely tight. Cost for labor and material—4″ averaged 14 cts.; 8″, 21 cts.; 12″, 30.5 cts.; 20″, 55 cts.[A13]

Customer accounting practice is tending to return from the stub to the ledger plan, although no marked trend is yet under way. This conclusion is based on reports by 194 utility companies, of which 72 were water companies. Of the water companies, 21 are using the stub plan, 6 the register sheet, 43 the ledger and 2 some other. If they were to instal a new system, 23 would prefer the stub, 4 the register sheet, 43 the ledger and 2 some other. These are net. Of the 194 companies, 9 would drop the stub plan and 5 would change to it; 4 would drop the register plan and 3 change to it; 4 would drop the ledger plan and 8 change to it. Advantages claimed for the stub plan—flexibility, easy and speedy operation; ability to note visibly the status of collections; disadvantages—does not give sufficient information unless supplemented with history record cards or other auxiliary record system, which offsets the economy feature of the stub plan.[A2]

Aerator illumination is used for publicity by the Waukesha, Wis., Water Dept. A well 1,903 ft. deep, 16″-12″ casing, produces 1,100 gpm which is pumped to an aerator elevated above the other buildings and illuminated at night. It is encased in a glass dome octagonal in plan, 27′ inside diameter and 16′ high; aluminum frame supporting ¼″ plate glass sides. Water from the riser pipe falls through an octagonal fine-mesh copper screen, which spreads it over a corrugated glass cascade. In the bottom of the structure are 12 colored lights, red, green and amber, constantly changed by a G. E. selective flasher, giving 13,500 watts illumination. By this the iron content is reduced by about 0.15 ppm.[J6]

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c, Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

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18. Recent Progress in the Elimination of Tastes and Odors from Water Supplies. By C. R. Cox, pp. 1855-1867.
19. Modifying an Unusual Filter Plant to Operate Successfully. By W. W. Hurlbut, pp. 1868-1872.
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10. When Mercury Flirts with Zero. By W. W. Brush, pp. 1654-1659.
11. Laboratory Control: Determination of the Total Iron Content of Water. By C. R. Cox, pp. 1663-1665.
12. Modern Accounting System Adopted by Owosso, Mich., Water Dept. By C. M. Waters, pp. 1671, 1683.
13. What Happened in One of the Coldest Spots in the Country. By H. B. Sharp, p. 1683.

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14. Static Head Main Takes Place of Distribution Reservoir. By W. A. Kunigk, pp. 16-18.
15. *p.* Chlorine and Ammonia Hazards. By H. H. Gerstein, pp. 19-21.
16. Water Consumer Census Aids City to Plan Water Systems. By T. G. Banks, p. 24.
17. Laboratory Control: Determination of Total Manganese. By C. R. Cox, pp. 25-26.
18. Improvement in Billing System Results in Greater Accuracy. By J. M. Boos, p. 29.
19. *p.* Curative Spring Waters Help to Develop a City and Its Water Works. By A. P. Kuranz, pp. 34, 37.

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8. *n.* New Hydraulic Laboratory of Univ. of Minnesota, p. 18.
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When you need special information—consult the *classified* READERS' SERVICE DEPT., pages 59-61

Engineering Conventions of the Month

American Road Builders, American Society of Civil Engineers, New York Sewage Works, National Paving Brick and Others Meet

January was a big month for engineering associations, and the engineer who took in all of the meetings was able to do but little else. Most of these were well worth attending, however, and apparently a good many thought this would be the case, because attendance was, for the most part, unusually good.

The American Road Builders Association

Road builders gathered at New Orleans, January 11 to 15, for the ARBA meeting and the "little" road show, so-called because exhibits were limited to models and similar displays. The weather was warm, but otherwise favorable, and quite a contrast to the two preceding meetings, both of which were marked by major blizzards and severe cold weather.

Election of officers was as follows: W. T. Chevalier, Jas. H. MacDonald and Charles M. Upham were reelected as president, treasurer and secretary respectively. District vice-presidents: Alexander Hancock, Mobile; J. D. Manley, Leesburg, Fla.; W. A. Olen, Clintonville, Wisc.; vice-presidents at-large: H. G. Sours, Akron; J. A. Bromley, Annapolis, Md.; F. J. McDevitt, St. Louis; and Wm. Parrish, Chicago.

The programs and committee reports covered a wide range of subjects, but especial attention was given to highway safety, to which two important sessions were devoted. Widening and straightening highways, the elimination or control of dangerous intersections, proper traffic control and lane separation were stressed as important in the consideration of safety from the engineering viewpoint. To this might be added the construction of *more* roads.

Stabilization continued an important place in all topics on low cost road construction, this including both chemical and bituminous stabilization. Naturally, drainage came in for an important place in discussing these types, since without proper drainage and preparation of the sub-base, satisfactory use of natural soil is difficult or impossible.

American Society of Civil Engineers

The annual meeting of this society was held in New York City January 19 to 22. L. C. Hill, consulting engineer of Los Angeles was elected president, succeeding Daniel W. Mead. Other officers included: Commander Lyle F. Bellinger, of Washington, and Roy C. Gowdy, of Denver, vice-presidents, and the following directors: Colonel William J. Shea and Enoch R. Needles, of New York; Arthur W. Dean, of Boston; Rowland P. Davis, of Morgantown, W. Va.; T. Keith Legare, of Columbia, S. C. and Thomas E. Stanton, Jr., of Sacramento, Calif.

The John Fritz Medal, one of the highest of American engineering honors, was awarded to Professor Arthur N. Talbot, of the University of Illinois, with the citation "moulder of men, eminent consultant on engineering projects, leader of research and outstanding educator in civil engineering"

Thomas Fitch Rowland prize to A. V. Karpov, designing engineer, Aluminum Company of America, Pittsburgh, and R. L. Templin, chief engineer of tests of the same company, for their paper on "Model of Calderwood Arch Dam."

James Laurie prize to Paul Baumann, junior assistant chief engineer, Los Angeles County Flood Control District, for his paper on "Analysis of Sheet-Pile Bulkheads."

Harry E. Miller of the University of Michigan was elected chairman of the sanitary engineering division, succeeding H. Burdette Cleveland, who has served for some years past.

New York State Sewage Works Association

This association held its winter meeting in New York, January 22 and 23 in conjunction with the Sanitary Engineering Division of the American Society of Civil Engineers. A joint dinner, which was very well attended, was held January 21, after the sanitary engineering division meetings had been thrown open to members of the NYSSWA. On Friday, the situation was reversed, and the ASCE members attended the sessions and luncheon of the Sewage Works Association. Milton Spiegel of the Chicago Pump Co. opened the session with a paper on Oxygen Utilization by Activated Sludge; Prof. Charles Gilman Hyde spoke at the luncheon meeting; afterwards there were papers by Prof. C. L. Walker of Cornell on the Effect of Activated Carbon on Sludge Digestion; by Prof. William M. Malcolm of Queens College (Kingston, Canada) reporting Studies in the Digestion of Ground Garbage; by Richard H. Gould and Wellington Donaldson on New York City sewage treatment problems and by H. B. Diehl of the Reeves Pulley Co. on Variable Speed Equipment and Control in Sewage Treatment.

C. C. Agar, of the New York State Department of Health, was elected president, and F. J. Biele of Huntington, L. I., vice-president, A. S. Bedell was re-elected secretary. Directors elected were E. J. Kilcawley, N. L. Nussbaumer and Charles McBreen, succeeding Morris Cohn, L. H. Enslow and Thorndike Saville. The Kenneth Allen Memorial awards were presented to A. J. Fischer of the Dorr Co. of New York and C. George Anderson of Rockville Centre.

National Paving Brick Association

The 31st annual meeting of this association was held in Detroit, Mich., Jan. 27 to 29. The meetings of the first day were devoted to Association affairs, but the other two days were open to engineers and others interested. Papers presented at the two final days' sessions included a symposium on reconstruction with brick, in which George Schoonmaker, Service Director of Toledo, O., H. W. Eustance, city engineer of Ithaca, N. Y., and Geo. M. Shepard, chief engineer of the St. Paul, Minn., Dept. of Public Works, joined. B. W. Wright of the Ohio Highway Dept. described a Longitudinal Brick Project, which was discussed by V. N. Holderman, superintendent for Beightler & Hussey, contractors. Paving brick in stadium construction was discussed by J. Davis Wilson, architect, of New Philadelphia, O. A report of the Research Bureau of the Association, H. Z. Schofield, director, was discussed by the following: F. H. Jackson, senior engineer of tests, Bureau of Public Roads; R. R. Litehiser, chief engineer of tests, Ohio Highway Department; G. E. Martin, consulting engineer, the Barrett Co.; P. D. Gephart, manager of asphalt sales of H. H. Robertson Co.; and W. H. Duecker of the Mellon Institute of Industrial Research.

Following this, base course design was discussed by K. L. Rothermund, chief engineer of the Bureau of Location and Design of the Ohio Highway Department and V. B. Steinbaugh of the Michigan Highway Department; Highway Safety was discussed by Prof. Roger L. Morrison, President of the Institute of Traffic Engineers, University of Michigan; and Diversion of Highway Funds by Murray D. Van Wagonen, state highway commissioner of Michigan.

Texas Water Works School

The nineteenth annual session of the Texas Water Works School will be held at A & M College, College Station, Texas from February 15-20, inclusive. During the past year, the Manual Committee of the Texas Water Works Association has been engaged in writing a comprehensive manual for water plant operators to use as a guide in their daily routine operations. The school program features the manual data for this year. There is a different author for each chapter and each is to be allotted time for explaining his

chapter and receiving suggestions and criticisms to aid in the betterment of his chapter. The school is divided, as usual, into two sections which run concurrent: one for water superintendents, and the second section dealing with laboratory procedures. Dr. W. T. Gooch of Baylor University, Waco, Texas will discuss "Certification of Water Plant Operators" and C. C. Hays of Waco, Texas will discuss "Preparation of Media and Glassware for Bacterial Tests."

Maryland-Delaware Water Sewage Assn.

The eleventh annual conference of this association will be held in Wilmington, Del., May 6 and 7. A. W. Blohm, 2411 No. Charles St., Baltimore, Md., is secretary.

Southeastern Section American Water Works Association

A joint meeting of the Kentucky-Tennessee and the Southeastern Sections of the American Water Works Association will be held in Chattanooga, Tennessee, April 5, 6, and 7, 1937. This eliminates the previously announced dates which were as follows: Kentucky-Tennessee Section April 12-14, and Southeastern Section April 6-8. W. H. Weir, 135 State Capitol Bldg., Atlanta, Ga., is secretary.

American Water Works Association

The 1937 Annual Convention of this Association will be held at Buffalo, N. Y., June 7 to 11, 1937, with headquarters at the Hotel Statler. Harry E. Jordan, 33 W. 39th St., New York, is secretary.

Personal News:

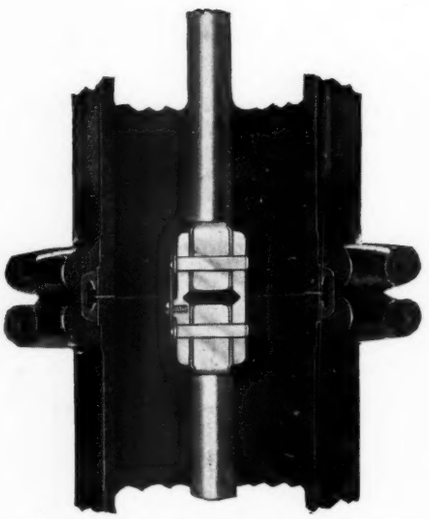
Robert E. Harper of New Orleans, has been appointed director of publicity, American Road Builders' Assn., succeeding Cliff Sherrill, who has resigned.

E. M. Fleming has been appointed Regional Manager of the Eastern offices of the Portland Cement Assn., with headquarters in New York. H. J. McDargh has been named Southeastern Regional Manager, with headquarters in Atlanta, Ga.

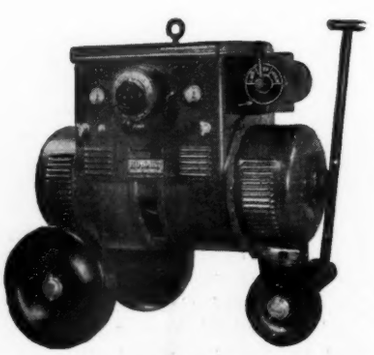
M. D. Davis, formerly vice-president in charge of sales, S. R. Dresser Mfg. Co., Bradford, Pa., has been made executive vice-president. H. P. Boncher, formerly assistant sales manager, has been promoted to sales manager. R. E. Reimer has been made assistant general manager. H. N. Malton continues as president and general manager; F. A. Miller is chairman of the board.

George D. Shaeffer, for the past year with Allis-Chalmers, has returned to the W. A. Riddell Co., Bucyrus, O., as chief engineer in charge of the Road Machinery Division. N. E. Jersey is in charge of Road Machinery Division sales.

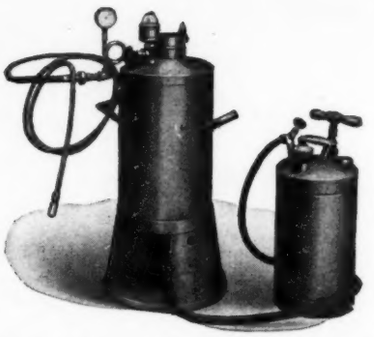
Repairing a leak in a water pipe with Dresser equipment. The pictures tell the story of how it is done.



Section of Protectop Hydrant, described at the right, showing joint.



Hobart Bros., Troy, O., Series MN electric welder with current saver and selective motor control, which lowers starting current requirements and cuts current costs.



The Hauck superheated steam thawer burns gasoline, and will supply steam in one minute after placing lighted burner under the boiler, and gives a steady flow of superheated steam in 2 minutes. Water storage capacity 5 gals., sufficient for 50 minutes operation. Gasoline consumption at maximum capacity ½ gal. per hour. Thaws hydrants, culverts, sewers, water and gas pipes, etc. Details from Hauck Mfg. Co., 126-134 Tenth St., Brooklyn, N. Y.

Smith "Protectop" Hydrant:

A hydrant so constructed, both as to standpipe barrel and main stem, that any sudden impact, such as being struck by an automobile, will cause it to break only at one point where it can be quickly and cheaply repaired, has been placed on the market by The A. P. Smith Manufacturing Company of East Orange, New Jersey. It is known as the "Protectop" model.

The hydrant barrel is made in two sections and joined together a few inches above the ground line by a water tight cast iron coupling ring having an interior rubber gasket. This coupling is designed with a reduced thickness of metal at its middle section, which extends entirely around the hydrant. This coupling ring can be easily and cheaply replaced.

The hydrant main stem is made up of a lower and upper rod joined together with a special coupling. This main stem coupling is assembled in line with the coupling on the hydrant barrel and any impact great enough to break the barrel coupling will break the main stem coupling also, and no further damage can be caused.

After collision, the combined cost of the standpipe coupling ring and of the main stem connecting piece is within $5 and the time required to replace these parts and put the Hydrant in service again is approximately fifteen minutes.

P&H Shovel on Wisconsin's Largest Rock Cut:

What is claimed as being Wisconsin's largest rock cut has recently been completed with the help of the new model 705 P&H Shovel on highway 14, near La Crosse, Wisconsin. Almost 100 feet wide, with a length of 1.1 miles, and grade width of 38 feet, this cut was made in 100% limestone rock. In completing this job the new P&H model 705 was required to move over 75,000 cubic yards of rock along with 75,000 cubic yards of dirt.

New Equipment Data and Pictures

New Dry Chemical Weighing Feeder

To dose water very accurately with dry chemicals by actual weight, the Syntron Company, of Pittsburgh, Pennsylvania, have developed a continuous, batch weighing feeder machine. This weighs out the desired amount of material in batches, and discharges them every 15, 30, 45 or 60 seconds, by electric clock timing.

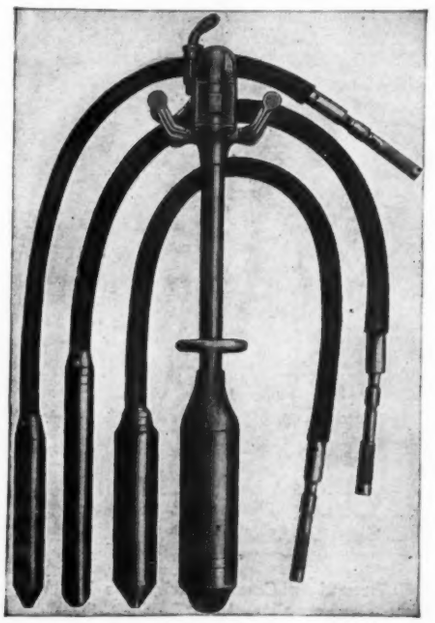
The machine is made up of: (a) A supply hopper equipped with a noiseless electric vibrator that prevents any arching or clogging of material. (b) A vibratory feeder that flows the material from the supply hopper to a weigh hopper. (c) An even balance scale, equipped with electric controls that stop the feeder when the right amount of material has been fed into the weigh hopper. (d) An electric clock control that dumps the contents into the solution pot.

New Syntron Feeder for all dry chemicals.

Capacity of the Model WMO-25 is from ⅛ ounce batches to 1-pound batches per discharge. Larger models are also available. Materials handled successfully include activated carbon, hydrated lime, soda ash, alum, and small lump lime. Materials are dumped through a dust-sealed chute. In operation, these machines have an accuracy of within plus or minus ½%, giving the filter plant operators the ability to feed chemicals accurately by actual weight.

Heated Concrete Mixer for Bituminous Paving

The city of Columbus, Ohio, attached a Littleford concrete heater unit to a concrete mixer and used this outfit for heating the stone for a bituminous paving job. The heated mixer discharges the warm stone into the skip of the bituminous mixer.



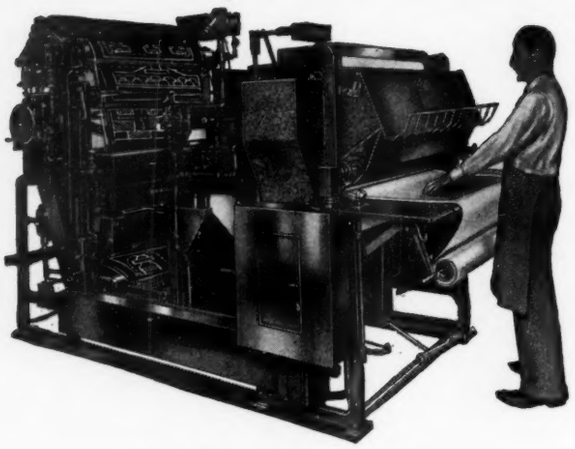
Concrete vibrators of the Chicago Pneumatic Tool Co., New York, N. Y. There are four vibrators shown here, for use on all kinds of concrete. For description ask for Bulletin SP 1955.

This new Hug equipment uses diesel power.

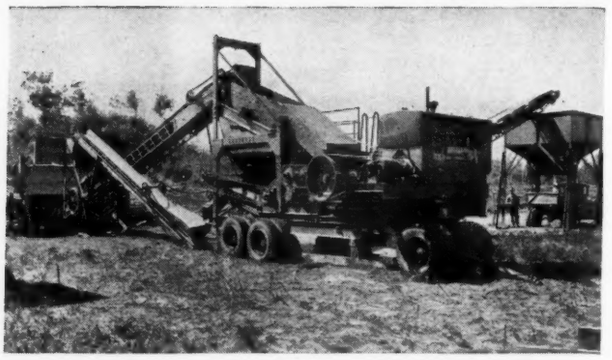
The Model 30 Hug Lugger With Diesel Power

The Hug Company, Highland, Illinois, has announced their new Model 30 Hug Lugger with "Show Down" Caterpillar Diesel Engine. Using low cost Diesel fuels, unusually economical operation is claimed for this new hauling unit. The engine is the Caterpillar D8800 Diesel, four cycle, water cooled, with a displacement of 831 cubic inches and A.M.A. rating of 52.9. Transmission provides 12 speeds forward and three reverse. The Hug set-back wheel design allows exceptionally short turning radius and ease of handling. The entire frame is electrically arc welded. Trusses, spring hangers, motor hangers, radius rod braces and box section cross members are all electrically arc welded to the side rails forming one rigid structure. The body is the Hug "Scoop End" body with direct reversible high dumping angle hoist. There is no tail gate and the body sides are re-inforced with "I" beam steel ribs. Body is of 10-yard capacity and the maximum pay load of the unit is 30,000 pounds.

S-O Model, controlled ignition, diesel tractors—newly announced by Allis-Chalmers. About 60-65 hp. Weighs 9 tons. Suited for 8-yd. scrapers; 10 and 12-ft. graders and 8-12-yd. wagons.



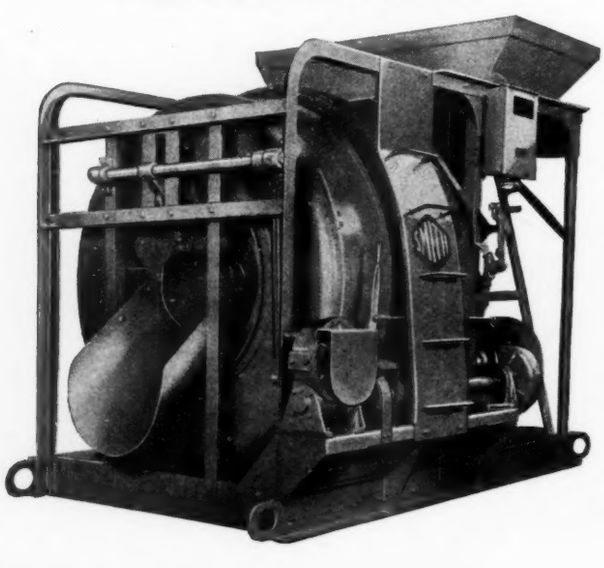
The Pease Blue-Print Machine



Universal dual crushing, screening and loading plant is portable. Made in capacities of 100 to 200 tons per hour. Includes a 9x36 jaw crusher, 30x16 roll crusher, 4x8 ft. double deck gyrating screen, and sand rejector. Bin capacity 21 cu. yds. Descriptive data from Universal Crusher Co., Cedar Rapids, Ia.

Above is shown the new Le Tourneau Type U Expanding Carryall, which is built in 18-yd., 12-yd., 9-yd. and 6-yd. capacity. In this, the bowl consists of two buckets, the rear one telescoping within the front one, giving greater capacity and also, it is said, facilitating both loading and dumping. The cutting edge of the new 18-yd. is the same as for the former 12-yd., so little extra tractor effort is required in loading.

Below: The new Smith Concrete Mixer



Smith 28-S Non-Tilt Mixer

The T. L. Smith Company of Milwaukee, Wisc., have brought out a new 28-S Non-Tilt mixer. A variable speed drive makes the machine equally efficient on either dry or wet batches. The drum is extra big in diameter and narrow, for faster charging and discharging. It is equipped with renewable full-width liners and full-width converging buckets. Wearing edges of buckets are coated with an unusually hard alloy metal which is claimed to increase their useful life materially.

"Proportioneers" Ready to Do Their Part

Calamities due to the floods make a demand on the American people for generous giving of money and clothing. But there are many more needs which can be supplied by only a few, among them preventives and remedies for the diseases which accompany and follow great floods, chief of which are those caused by polluted drinking water. To meet this emergency, chlorine and chlorine feeders are needed in great quantities.

"Proportioneers," of Providence, R. I., are anxious to do their part in filling this need. Last month it offered to the several state boards of health to "ship you any number" of heavy-duty midget chloro-feeders with accessories ready for installation. Your sanitary engineers can easily make your installation in a couple of hours. These would be supplied on memo billings which would be cancelled upon return of the chloro-feeders. If you need any man power, we will be glad to have our nearest representative or perhaps a factory representative placed at your disposal to assist in any sterilization problems where we could help. Wire us your requirements, as any number of 'midgets' can be shipped immediately from stock." The company asks us to say that the same service is offered to any water works superintendent suffering an emergency who may need a chloro-feeder temporarily or permanently.

A similar offer made last spring at the time of the New England floods was accepted by a number of cities.

Steam Thawing Unit:

Bryan Steam Corp., Peru, Ind., have developed a steam thawing unit that thaws and then siphons water out. It develops more than 500° superheat and produces 60 pounds of steam in 15 minutes. It is claimed that it will thaw a frozen fire hydrant in 2 minutes. Available for many kinds of city and country work. Data on request.

Readers' Service Department

These booklets are FREE to readers of PUBLIC WORKS.

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and heavy duty highways, and for all other sewer construction where replacement, repairs or reconstruction would be costly, cast iron pipe is most economical. For details, specifications, etc., write Thomas F. Wolfe, Cast Iron Pipe Research Ass'n, 1013 Peoples Gas Bldg., Chicago, Ill.

Couplings for Pipe

386. This sixteen-page booklet is a reprint of a magazine article by a consulting engineer. It describes in detail the installation of a 42" water line; contains specific information regarding pipe joints, field organization, laying pipe, tests, back-filling, etc. Sent free by S. R. Dresser Manufacturing Company, Bradford, Pa.

Feeders, Chlorine and Chemical

387. For chlorinating small water supplies, swimming pools and other installations. Flow of water controls dosage of chlorine (or other chemicals) providing required dosages, which are immediately adjustable. Driving is started and stopped automatically. Send for newest literature. %Proportioneers%, 9 Codding St., Providence, R. I.

Fire Hydrants

388. Two new bulletins on M-H fire hydrants and fully bronze mounted gate valves are now ready. Contain full specifications and instructions for ordering, installing, repairing, lengthening and using. Write M. & H. Valve & Fitting Co., Anniston, Ala.

Gate Valves

390. 28 page catalog contains illustrations and complete specifications of M-H standard and extra heavy iron body gate valves, horizontal swing check valves, flanged fittings and flanges, etc. Sent promptly on request by M. & H. Valve & Fittings Co., Anniston, Ala.

Manhole Covers and Inlets

403. Nuisance from loose, noisy manhole covers is eliminated by the use of Westeel rubber cushioned manhole covers and gratings. Six special advantages are explained in a new illustrated bulletin just issued by the West Steel Casting Co., 805 East 70th St., Cleveland, Ohio.

404. Street, sewer and water castings made of wear-resisting chilled iron in various styles, sizes and weights. Manhole covers, water meter covers, adjustable curb inlets, gutter, crossing plates, valve and lamphole covers, ventilators, etc. Described in catalog issued by South Bend Foundry Co., South Bend, Ind.

Pipe, Cast Iron

406. Data on cast iron pipe for water works systems, in sizes from 1¼ to 84 inches, including information on useful life, flow data, dimensions, etc., Thos. F. Wolfe, Cast Iron Pipe Research Ass'n, 1013 Peoples Gas Bldg., Chicago, Ill.

Pipe, 2-inch Cast Iron

407. The new McWane 2" cast iron pipe in 18-foot lengths has innumerable uses in water and sewage work. Send for the new McWane bulletin describing this pipe, the various joints used, and other details about it. McWane Cast Iron Pipe Co., Birmingham, Ala.

Pipe, Concrete

408. Concrete Pipe Sewers, a 28-page booklet, contains much valuable information and numerous illustrations on concrete pipe. Issued by American Concrete Pipe Association, 33 West Grand Ave., Chicago.

Pipe Forms

409. Making concrete pipe on the job to give employment at home is the subject of a new booklet just issued by Quinn Wire and Iron Works, 1621 Twelfth St., Boone, Ia., manufacturers of "Heavy Duty" Pipe Forms. Sent promptly on request.

Pipe Joints

410. New folder describes in detail a new type of pipe joint—the Dresser Compression Coupling, Style 65, which is compact and self contained, makes a permanently tight joint under all conditions and is installed on plain end pipe in a few seconds with only one tool, a wrench. Get your copy today. S. R. Dresser Mfg. Co., Bradford, Pa.

Pipe Joint Compound

411. A new bulletin has recently been issued giving full details concerning Tegul Mineralead, a quick-sealing, trouble-free compound for bell and spigot joints which permits immediate closing of the trenches. Write The Atlas Mineral Products Co. of Pa., Mertztown, Pa.

412. New plastic sewer pipe joint compound, Servitite, contains chemicals which positively prevent root growth and gives watertight joint. Get complete information from Servicised Products Corp., 6046 West 65 St., Chicago, Ill.

Taste and Odor Control

413. How, when, and where activated carbon can and should be used to remove all kinds of tastes and odors from water supplies is told in a new booklet just issued by Industrial Chemical Sales Div., 230 Park Ave., New York, N. Y. 32 pages, table, illustrations and usable data.

Pumps and Well Water Systems

414. Installation views and sectional scenes on Layne Vertical Centrifugal and Vertical Turbine Pumps, fully illustrated and including useful engineering data section. Layne Shutter Screens for Gravel Wall Wells. Write for these three descriptive booklets. Layne & Bowler, Inc., Dept. W, General Office Memphis, Tenn.

Protective Pipe Coating

415. Coal-tar Pitch Enamels for exterior and interior linings for steel water lines; highly resistant to water absorption, soil acids and alkalis. Technical specifications for materials and their application will be sent on request. The Barrett Company, 40 Rector St., New York, N. Y.

Pumping Engines

417. "When Power Is Down," gives recommendations of models for standby services for all power requirements. Sterling Engine Company, Buffalo, N. Y.

Rubber Lined Pipes and Pumps

418. New, 68-page catalog describes Ace rubber lined pipe and fittings, hard or soft rubber lined centrifugal pumps and Ace hard rubber double acting pumps, for chemicals used in treating sewage and water and for acids and other corrosive liquids. Contains illustrations and specifications. Issued by American Hard Rubber Co., 11 Mercer St., New York, N. Y.

Run-off and Stream-Flow

420. Excellent booklet describes and illustrates the latest types of instruments for measuring run-off, both from small areas for storm sewer design, and from large areas for determining water shed yield. Sent promptly by Julien P. Friez & Sons, Baltimore, Md.

Screens, Sewage

421. The simple, automatic Loughlin, self-cleaning, traveling screen is fully described in an interesting bulletin issued by Filtration Equipment Co., 10 East 40th St., New York, N. Y.

423. Be asurred of uninterrupted, constant automatic removal of screenings. Folder 1587 tells how. Gives some of the outstanding advantages of "Straightline Bar Screens" (Vertical and Inclined types). Link-Belt Co., 307 N. Michigan Avenue, Chicago, Ill.

Setting and Testing Equipment for Water Meters

424. All about setting and testing equipment for Water Meters—a beautifully printed and illustrated 40 page booklet giving full details concerning Ford setting and testing apparatus for all climates. Ford Meter Box Co., Wabash, Ind.

Rainfall Measurement

429. The measurement of precipitation, exposure of gauges, description of apparatus for measuring rainfall, both rates and amounts. Bulletin RG and Instruction Booklet. Julien P. Friez & Sons, Baltimore, Md.

Screens

430. Water Screen Book No. 1252, describes traveling water intake screens and gives complete technical information about them. Link-Belt Co., 307 No. Michigan Ave., Chicago, Ill.

Sludge Bed Glass Covers

432. Sludge Bed Glass Covers—"Super-Frame." Hitchings & Co., Elizabeth, N. J. offer A. I. A. File 101 SB, describing glass covers for sludge and sprinkler beds; details, specifications and cost data.

Sludge Incineration

438. A multiple hearth furnace which meets the most exacting municipal sanitary requirements for the incineration of sewage sludge—produces a fine ash or partially dry sludge for fertilizer—is described and illustrated with drawings and photographs in bulletins issued by Nichols Engineering and Research Corp., 40 Wall St., New York, N. Y. Operation as well as installation data is given.

440. Disposal of Municipal Refuse: Planning a disposal system; specifications. The production of refuse, weights, volume, characteristics. Fuel requirements for incineration. Suggestions for plant inspection, 45 pp., ill. Also detailed outline of factors involved in preparation of plans and specifications. Morse-Boulger Destructor Co., 202P East 44th St., N. Y.

Swimming Pool Equipment

444. Filters, chlorination, underwater lights and other supplies for swimming pools are very thoroughly described in literature and folders. Plans and layouts. Everson Filter Co., 625 W. Lake St., Chicago, Ill.

445. Data and complete information on swimming pool filters and recirculation plants; also on water filters and filtration equipment. For data, prices, plans, etc., write Roberts Filter Mfg. Co., 640 Columbia Ave., Darby, Pa.

Treatment

448. New 31-page catalog covers complete conveying, screening and reduction machinery for water purification and sewage treatment; describes and illustrates the design features of Jeffrey self-cleaning bar screen, combined screen and grinder, sewage screenings grinder, grit washer, conveyor type and positive discharge sludge collectors and green garbage grinder—includes installation views. Catalog 615, Jeffrey Manufacturing Co., Columbus, Ohio.

450. Standard Sewage Siphons for small disposal plants and PFT Rotary Distributors are new catalogs recently issued by Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago, Ill. The latter catalog contains typical plans and many illustrations of actual installations.

452. Eliminate sludge bed troubles, forget about weather conditions, odor nuisance, hail insurance and the like. Full details as to how Oliver United Vacuum Filters overcome these problems will be sent to all interested by Oliver United Filters, Inc., 33 West 42nd St., New York, N. Y.

453. How to avoid sludge and scum troubles in settling tanks explained in detail in Book No. 1542—has excellent drawings and photographs, also specifications. Most important are the carefully prepared capacity tables. Link-Belt Co., 307 N. Michigan Ave., Chicago, Illinois.

454. Full information regarding their newest equipment for sewage treatment and water purification will be sent on request by The Dorr Co., 247 Park Ave., New York, N. Y.

Thawing Equipment

460. Complete details concerning this quick-acting, efficient, electric pipe thawer which sells for only $39.25 complete, will be sent promptly by Commonwealth Mfg. Corp., Dept. P-710, 3785 Beachmont Ave., Cincinnati, Ohio.

For the Engineer's Library

The editors will be glad to assist readers in getting copies of publications mentioned here.

The Koppers Book:

A beautiful booklet, issued by Koppers Co., Pittsburgh, Pa., to illustrate the scope of activities of this organization. One of the most attractive and instructive booklets that has come to the editor's desk. The center spread pictures by colored flow chart what happens to a ton of bituminous coal as it passes through a coke plant. We believe it will be sent on request.

Water Works Operating Practices; Kinks and Gadgets:

This is a reprint of two excellent papers by F. E. Stuart in the American Waterworks Assn. Journal. In the first are outlined a number of filtration and field practices of value. In the second are presented a whole lot of kinks—the kind that will help you on your work. Mr. Stuart has picked these up in his visits to a thousand or more waterworks plants. Reprint will be sent on request to Fred Stuart, Activated Alum Corp., 80 Broad St., N. Y.

Aluminum Paint:

This 45-page book includes a report of developments in aluminum paint and an outline of the requirements of different forms of maintenance painting: Interior, exterior, walls, ceilings, stacks, tanks, heated surfaces, etc. The proper type of Permite Ready-Mixed Aluminum Paint to use for each purpose is described and illustrated. Included also is an interesting chart showing the types and physical properties of Permite Ready-Mixed Aluminum Paint for different applications, such as the oil length, viscosity, drying time, baking time, percentage of thinning required, etc., etc. Sent without obligation to any executive who writes on his letterhead to Aluminum Industries, Inc., Cincinnati, Ohio.

The Shape of Road Aggregate And Its Measurement:

(Road Research Bulletin No. 2. Published H. M. Stationery Office 6d. net)

For many years it has been held by road engineers that flaky and elongated material is undesirable in aggregate intended for road construction. Whilst there appear to be no records of actual failure which could be attributed to flaky material, there is widespread unanimity of opinion that this material is unsatisfactory. This opinion finds expression, for example, in British standard specifications for rolled asphalt which require a stone to be "angular but not flaky." The Department of Scientific and Industrial Research and the Ministry of Transport have recently issued jointly a bulletin setting forth briefly, results obtained at the Department's Road Research Laboratory in connection with the measurement of the shape characteristics of broken stone and other similar materials and the practical application of the methods devised. In view of the fact that the degree of flakiness permissible in an aggregate must depend at present on the judgment of the engineer, and since deliveries will normally be compared with the approved samples no limits governing the maximum percentage of long and flaky material acceptable have been suggested. It is pointed out that flakiness in a crusher-run aggregate commonly varies with size, a fact which, it is thought, is not always appreciated.

Roofing Specifications:

A booklet of standard roofing specifications, written in blank, ready to be incorporated with architectural or engineering master specifications without alteration, is being published for free distribution by the Tar and Chemical Division of Koppers Company, Pittsburgh, Pa. The specifications do not restrict themselves to any particular manufacturer's product. Complete specifications for all types of coal tar pitch and tarred felt roofs are included in the book. They include applications over wood decks, concrete or poured gypsum, pre-cast concrete or gypsum, book tile, steel deck or under promenade tile. There also are sections on spray pond or water cooled roofs, roofing insulation, waterproofing and damp-proofing, flashing specifications and metal finishing strip details. Diagrams for each particular application accompany every set of specifications.

Calcium-Chloride-Stabilization Of Roads:

A new bulletin on "Low Cost Roads Stabilized with Aggregates, Binder Soil and Calcium Chloride" has just been issued by the Calcium Chloride Association, covering specifications, design of mixtures, construction and maintenance. Illustrated with pictures and charts, this bulletin tells, in 85 pages, practically the whole story of soil-stabilization. In addition to the data on procedure, the manual contains a bibliography of outstanding articles and reports on the subject and a glossary of terms most commonly used. Ask for Bulletin No. 25, sent on request to Calcium Chloride Association, 4145 Penobscot Building, Detroit, Michigan.

Feed Water Deaerators:

Cochrane Corp., Philadelphia, Pa., publication 2540, discusses the prevention of corrosion by a complete removal of oxygen and dissolved gases from the feed water in modern steam plants. 16 pp., ill., sent on request.

Index to Advertisements